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THE

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THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXII.] APRIL 15, 1935 [No. 1.

The Flower and Seed of *Mollugo verticillata*[*]

SISTER M. ANTHONY PAYNE, O. S. B.

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ABSTRACT: The morphology and microscopic anatomy of the leaf, stem and root of *Mollugo verticillata* have been discussed in a previous issue of the SCIENCE BULLETIN. The present paper traces the development of the seed from its primordium to the resting stage.

The technic employed in preparing the flowers for microscopic study greatly facilitated the work, for clusters of flowers, embedded *en masse,* contained ovules and seeds in all stages of development. The Botany Department of the University has excellent photographic apparatus, hence the different stages of development could be photographed and the paper is illustrated by thirty photomicrographs.

The primordium of the ovule, a protuberance of slightly differentiated tissue, continues to differentiate until the megaspore cell that is destined to survive, as well as the epidermal layer and rows of nucelli, have formed. The two outer rows of cells eventually give rise to the outer integument and from the next two rows the inner integument differentiates. The megaspore grows into a large egg-shaped cell which lies in the distal third of the ovule. It has granular cytoplasm and a large nucleus.

The early development of the embryo sac is regular. After the differentiation of the egg, the embryo sac enlarges rapidly, following in its growth the curve of the developing kidney-shaped ovule. The egg cell when ready for

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[*] Contribution from the Department of Botany, University of Kansas.

fertilization lies at the mouth of a well-developed pathway which extends from the micropyle down through the nucellus tissue. After fertilization, a small, perfectly spherical embryo develops. Then the primordia of the cotyledons appear at the apical end.

The syncarpous superior gynoecium is composed of a three-loculed ovary plus the short style with its tripartite stigma. There are ten or more seeds in each locule, but only about three fifths of the seed is filled with endosperm. The seed is neither the "albuminous" nor the "ex-albuminous type," but intermediate.

The development of the testa is traced and the gradual utilization of stored nutrient material demonstrated by means of photomicrographs.

THE morphology and anatomy of the stem, leaf and root of *Mollugo verticillata* have been described previously (Kansas Bulletin, Vol. XXXIV). The present paper treats of the anatomy of the flower of the same plant. "Carpet weeds" were collected in dry, sandy spots near Lawrence during the latter part of August by Prof. W. C. Stevens, who fixed them in formalin-alcohol and later preserved them in 30 percent alcohol. The author takes this opportunity to express her deep gratitude to Professor Stevens for his kind help and invaluable direction during the progress of this study, also for the material and use of laboratory facilities in the Botany Department at the University of Kansas.

The flowers which occur in umbel-like clusters were removed individually or in clusters and run through the butyl-alcohol series into paraffin (Zirkle, '30). Flowers of one cluster vary greatly in age. Hence clusters of very young flowers were dehydrated and embedded at one time. Serial sections of these gave all stages of early growth at various angles and proved very satisfactory for the study of gametogenesis. Older flowers were embedded separately and cut either in longitudinal or cross sections.

Several methods of staining were employed, some combinations proving better for the microscopic study, others giving better light penetration for photomicrographs. Iron hematoxylin, followed by light green, gave very good results for both microscopic and photographic analyses. Fulgen's stain brought out several structures that were poorly contrasted by other stains. Fulgen's is particularly good for the study of the development and suberization of the endothecium in the anthers.

The usual microchemical tests for fats, starch, protein, lignification and suberization, etc., were employed in the analyses of cell contents and cell walls. (Stevens, '24.)

OVULE AND MEGASPORE

The primordium of the ovule is a protuberance of slightly differentiated tissue. By continued periclinal divisions, together with an occasional anticlinal one, the epidermal layer, rows of nucelli and the archesporial cell arise. It is difficult to pick out the archesporial cell at its inception, but as growth proceeds one of the apical cells at the micropylar end just under the epidermal wall divides and gives rise to two megaspore mother cells (Pl. I, fig. 1). After the second division the innermost megaspore cell is somewhat larger and can be readily recognized as the megaspore that is destined to survive. It continues to enlarge at the expense of the three degenerating basal megaspore cells and soon measures as much as 0.11 mm. in diameter. The surviving megaspore is rounded and has been pushed down into the basal part of the upper third of the ovule, which is bent on the elongating funiculus at an angle of about 50°. The aborting basal megaspore cells form a dark concave cap above the large terminal megaspore. The protoplasm of the megaspore is more alveolar than that in the cells of the adjacent nucellus, but its nucleus is not much larger than the nuclei in other cells.

The ovule, with the exception of the megaspore cells, consists of small square to rectangular cells. All have large nuclei and deeply staining protoplasts. When the megaspores are first formed and the basal megaspores start to degenerate, a section of an ovule consists of 16 or 18 rows of cells. The outer two rows form the outer integument. In length they are five or six cells shorter than the second integument, which is also formed of two rows of cells. The tips of the inner integument project beyond the body of the ovule, which is formed of definite rows of nucellus cells (Pl. I, fig. 2). As growth continues the megaspore comes to occupy a locus nearer the micropyle, due to the fact that it appropriates all the space formerly occupied by the basal megaspore cells as well as its own original space. It measures as much as 0.17 mm. by 0.11 and lies just under the two rows of nucellus cells at the tip of the ovule. It is a large, egg-shaped cell, with granular cytoplasm and a nucleus several times larger than the nuclei of neighboring cells.

A delicate reticulum ramifies throughout the body of the nucleus. There are large clumps of chromatin just under the nuclear membrane and a large heavy-staining chromatin-nucleolus is centrally placed (Pl. I, fig. 3).

THE EMBRYO SAC

The nucleus of the egg-shaped megaspore divides and at first the two nuclei lie close together. A few small vacuoles appear in the cytoplasm. Later these coalesce into a single large vacuole between the two nuclei. As this vacuole enlarges the two nuclei move further and further apart. Eventually they are but slightly removed from the polar ends of the cell. Each nucleus divides again, giving rise to the 4-nucleated embryo sac which is but slightly larger than the 2-nucleated embryo sac (Pl. I, fig. 5). It retains its shape and measures only 0.18 by 0.13 mm. Up to this stage of development there is no pronounced cytoplasmic change. The nucleus at the micropylar end of the embryo sac often divides before the nucleus at the antipodal end, giving rise to a 3-celled gametophyte.

The nuclei of the cells of the nucellus that are adjacent to the growing gametophyte develop a great affinity for basic stains. This change in staining reaction seems to be the first of a series of changes which results in the gradual disintegration of the nucellus material that borders the growing embryo sac.

The early development of the female gametophyte is typical and easily followed, for during the first stages of growth the entire embryo sac is relatively straight and lies in one plane. After the migration of the polar nuceli and the differentiation of the egg the embryo sac enlarges rapidly, elongates, and at the same time curves, following in its growth the outer margin of the kidney-shaped ovule. The method of growth of the embryo sac makes it difficult to secure an entire section through it, for sections of ovules usually contain only the basal, the apical or the middle portion of the greatly elongated sac (Pl. I, fig. 6).

The polar nuclei are small, and fusion occurs in the mid-region of the sac. The first division of the primary endospern nucleus has not been observed, but judging from a study of sections that precede and follow the mid-portion of the section shown in Plate II, figure 11, it is probable that the nucleus centrally located in the constricted region of the embryo sac is the primary endosperm nucleus.

The egg cell when ready for fertilization lies at the mouth of a well-developed pathway which extends from the micropyle down through the nucellus tissue. After the fusion of the male and female gametes the ovum remains attached at the basal end of the embryo sac (Pl. II, fig. 9). It is a large, rounded cell and soon divides by a transverse wall into two cells. This first division of the zygote marks the polarity of the embryo. A large vacuole appears in the basal cell which gives rise to the suspensor (Pl. II, fig. 10). The free apical cell, by successive divisions, gives rise to the embryo. From the quadrant stage it develops into a perfectly spherical embryo of 70 or 80 cells (Pl. II, fig. 12). After the large spherical form is attained the primordia of the cotyledons appear at the apical end of the embryo. The endosperm is clearly of the "nuclear" type, where cell division is distinctly later than nuclear division, and at this stage of development the endosperm consists of many nuclei in a peripheral layer of cytoplasm.

The nucellus cells at the micropylar end of the seed are smaller than those at the opposite end. The cytoplasm is dense and granular and only a very small vacuole is present. The walls of the outer row of nucellus cells become thickened and form a definite limiting layer, which is more highly specialized in that region of the seed which contains the young embryo. In early stages of development these cells contain living protoplasts, but in later stages the walls are cutinized and the cells appear lifeless.

STAMEN

The flower has three prominent stamens which mature long before the ovules are ready for fertilization. Each anther contains four elongated pollen sacs with a common vascular bundle entering the connective (Pl. III, fig. 16). Reduction-division occurs in the spore mother cell in the usual manner, each mother cell giving rise to a tetrad of spores (Pl. III, fig. 15). At the time that the heterotypic division occurs in the microspore mother cells the megaspore has just commenced to germinate.

The growing point, which later gives rise to the stamen, differentiates rapidly into the filament and anther tissue. At an early stage the sporogenous cells lie just under the epidermal layer at the distal end of the developing stamen. The walls of the single layer of isodimetric epidermal cells which surround the anther and continue on down the growing filament, are already somewhat thickened at this early stage of development. A firm protoplast fills the cell cavity and the nucleus is large and clearly defined (Pl. III, fig. 13).

There is some variation in the size and shape of the cells that form the mass of sporogenous tissue, but the differentiation at this stage of development is not sufficiently pronounced to distinguish between microspore mother cells and future tapetal cells. Although the origin of the tapetal cells has not been definitely determined, a study of cross sections of stamens in later stages of development suggests that each outer sporogenous cell, by periclinial division, gives rise to two daughter cells, the outer of which becomes a tapetal cell while the other daughter cell is sporogenous. A careful measurement of such daughter cells shows that the outer cell is tangentially elongated and that it contains much less cytoplasm than its sporogenous inner sister cell. The origin of the tapetum from the outer sporogenous cells, while not the rule, has been reported for many species: in Ranunculus by Coulter, '98; in Myosurus by Swingle, '08; in Magnolia and Liviodendron by Maneval; in Impatiens by Carroll, '19; etc.

The size difference becomes greatly accentuated in microspores and tapetal cells of older stamens. Here a longitudinal section shows one or two rows of very large, nearly quadrangular microspore mother cells, each row consisting of six or seven cells (Pl. III, fig. 14). The microspore mother cells are nearly two times wider than long, measuring approximately 0.07 mm. in width.

Adjacent to the microspore mother cells are two uneven rows of tapetal cells. The inner row of tapetal cells is composed of relatively large perfect cells, containing well-defined nuclei and evenly thickened walls. These cells average about 0.03 mm. in diameter. The outer row of tapetal cells is cramped and distorted. They lose their nuclei very early, and in older stamens have disappeared altogether, while the inner row of tapetal cells stains heavily and forms a definite wall. In sporangia containing tetrads of spores these cells do not enlarge greatly, and unlike the condition found in many other forms, in which the tapetum, at this stage of development is bi- or multi-nucleated, the majority of these cells are uninucleated. (Smith, '98; Stenar, '25, etc.) The cytoplasm is granular, the nucleus sharp and the walls definitely thickened. After reduction-division the tapetum degenerates, and in perfectly mature sporangia, only the walls of the tapetal cells remain at the periphery of the loculi. Many of these are broken or in the process of disintegration (Pl. III, fig. 16).

In young anthers the cells of the outer or epidermal layer have slightly thickened walls and well-developed protoplasts with large nuclei. In older anthers the protoplasts of the epidermal cells remote from the central connective degenerate, the walls thicken, and the entire cell becomes elongated (Pl. III, fig. 16), while the epidermis adjacent to the connective remains thin-walled, and its cells are large.

Just under the epidermis there is another layer of small, tangentially elongated cells which at first closely resembles the adjacent tapetum, but which later develops into a wall layer of the sporangium. The cells of this layer increase in size and radial thickenings form in the walls. The protoplast gradually disappears and, in the mature anthers, these cells, characteristically striped, form the greater part of the endothecium (Pl. III, fig. 18). The suberized thickenings or lines in the walls of the cells, running from the base of the cell out to the periphery, become evident only after special staining (Fulgen's). The mature endothecium remains bordered by the epidermal cells.

The four sporangia of the mature anther are crowded with spherical disc-shaped pollen grains. The exine, heavily cutinized, is covered with short rugae and contains four germ pores. In degenerating pollen grains the thinner intine has pulled away from the heavier outer membrane and the contents of the cell are lunar-shaped. The protoplasm is finely granular, stains heavily, and may contain three or four smaller vacuoles. The nucleus contains a large, round chromatin-nucleolus. Eventually the definite rounded nucleus divides into the generative nucleus and the tube nucleus. At first they are similar in size and shape, but soon the generative nucleus becomes appressed to the intine with a small cytoplasmic area organized about itself (Pl. III, fig. 16). The generative and tube nuclei are often found in the same pollen section, but at no time have three nuclei been seen in one pollen grain. Hence, it is probable that the generative nucleus does not give rise to the male nuclei while the pollen grain is still in the anther, which, however, according to Dudgeon, '18, is the case in *Rumex crispus*. Schnarf, '29, has noted that the two-nucleated or three-nucleated condition of the mature pollen grain is a constant condition within the species and is the rule with a family. In longitudinal sections of anthers, twelve to eighteen pollen grains measuring 0.08 mm. in diameter may be counted in one pollen sac (Pl. III, fig. 18).

THE SEED AND SEEDLING

The seeds of *Mollugo verticillata* are reddish brown, the brittle testa being characteristically marked. Rows of deep pits with striated floors run from the outer edge of the seed coat into the short funiculus, by which the plump, kidney-shaped seeds are attached to the placentae. Placentation is axile. A small vascular bundle lies near the center of each funiculus (Pl. IV, fig. 23). Each of the three locules of the mature ovary contains two rows of five or six seeds, there being approximately thirty seeds in each ovary.

About three fifths of the body of the seed is occupied by the young embryo which lies under the longer outer curved seed coat. The radicle and cotyledons of the embryo are well-developed, and a small plumule lies between the two thickened cotyledons. The cotyledons together are about equal in size to the well-developed radicle, which shows pronounced tissue differentiation very early in its growth. In the fresh unstained embryo the primordial meristem, and further back strands of differentiating cells, can easily be distinguished (Pl. III, fig. 20). The radicle points toward the micropylar end of the seed, the plumule lies under the mid-region of the outer curved wall of the seed coat, and the cotyledons fill the upper end of the seed. In Plate III, figure 21, part of the brittle testa has been removed and the cotyledons of the embryo are pictured *in situ.* The micropylar evagination is to one side of the short funiculus. In longitudinal sections of mature ovaries, the seeds are cut at various angles, showing the locus of the embryo in the seed, and its relation to the endosperm (Pl. III, fig. 19). The greater part of the endosperm is massed under the middle part of the embryo. Most of the embryonic tissue is embedded in or surrounded by endosperm, while the extreme upper ends of the cotyledons are closely appressed to the epidermis of the old nucellus tissue, with little or no endosperm intervening (Pl. III, fig. 17).

The cells of the embryo contain much oil and protein and are without starch. Thin sections may be stained with Sudan III and Scarlet R in order to test for fat. The test shows that all of the cells of the embryo contain many fat droplets, but that the peripheral layer of cells is literally filled with fat. If the fat is dissolved out of the embryonic tissue and a test for protein made, yellowish granules are seen in the protoplasts of all of the cells, except those in the peripheral layer. The amount of fat present in the resting embryo is greater than the amount of stored protein, although both are present in great abundance.

There are two seed coats, an outer and an inner. The outer seed coat is composed of brittle, cutinized, radially rectangular protective cells whose thick walls are pitted and of a characteristic yellow-brown color. A very thick cuticular layer, forming an impermeable coat for the mature seed, is gradually secreted by the outer protective coat (Pl. IV, fig. 27). In young ovules this outer epidermis is composed of living cells whose protoplasts contain innumerable fat droplets and five to eight large plastids which store polysaccharides (Pl. IV, fig. 22). The starch grains are gradually utilized, but the fat droplets increase in number and gradually coalesce to form large drops, which are later emulsified (Pl. IV, fig. 24). Finally the entire cell cavity is filled with an apparently homogeneous, milky-looking, fatty substance (Pl. IV, fig. 25). This later is utilized either by the growing seed or in the formation of the deep cuticular layer, for in the mature seed nothing remains of the outer seed coat but the thick, brittle, brownish-colored cell walls.

The inner seed coat consists of a layer of small, isodiametric, thin-walled parenchyma cells. Their protoplasts are crowded with large amyloplasts, some showing one, others several, centers of starch formation. All during the later stages of seed growth this nutritive layer contains large starch grains, and even in the mature seed the living cells have definite nuclei and healthy protoplasts. Plate IV, figure 29, is through the tip of a seed and shows the cuticular layer and the large rectangular cells of the outer seed coat overlying the thin-walled parenchyma of the inner seed coat.

The outer cutinized layer of nucellus cells forms an additional protective layer whose inner walls are also heavily cutinized, while the lateral and outer walls are much less thickened. The protoplasts, which do not degenerate until the endosperm of the seed is well developed, contain neither starch nor fat droplets (Pl. IV, fig. 27).

ENDOSPERM

The endosperm gives a positive reaction to starch tests. The starch grains in the cells are very small and exceedingly numerous. Traces of fat droplets appear throughout the endosperm.

Mollugo may be called an intermediate type of seed from the viewpoint of the amount of endosperm contained, for there is approximately a 60-40 distribution of embryonic and endosperm material. The embryo is relatively large and has cotyledons that are fairly well thickened, but masses of endosperm remain in contact with the embryo. Hence the condition is neither that which is found in the relatively primitive state where the "albuminous" seed contains much endosperm and a dependent, poorly developed embryo, nor is it similar to that which is found in the "ex-albuminous" type in which the embryo develops early and absorbs all of the endosperm material (Bower, '19).

ANATOMY OF SEPAL, GYNOECIUM, ETC.

The perianth is composed of five small, curved sepals. Each sepal is five or six cell layers in thickness, has three large nearly parallel veins with small transverse branches. The epidermis is composed of heavy-walled cells, noticeably larger on the upper surface than on the lower. The cells of the parenchyma tissue below this have large vacuoles and contain many large plastids. The protoplast of the border parenchyma of the veins is particularly rich in starch. The walls of the tracheal tubes in the vascular bundles are lignified (Pl. IV, fig. 28).

The pedicel of the flower is herbaceous, with a central vascular cylinder. The epidermis is flattened and has thickened outer walls. Several rows of parenchyma cells lie between the epidermis and the central cylinder. These large rounded cells have sparse cytoplasm, small nuclei and large vacuoles. The tracheal tubes have heavily lignified walls and are scattered irregularly among the thinner-walled xylem parenchyma cells. The stele broadens as the pedicel joins to the gynoecium, traces passing from it to the various floral organs.

The syncarpous superior gynoecium is composed of a three-loculed ovary which terminates in a short style with a tripartite stigma. The carpels are about five cell layers thick, and contain several vascular strands. The epidermal layer of cells that lines the outer margin of the locules has thickened outer walls, while in the mature ovary, the cells of the inner carpellary walls are greatly modified. They are columnar-like cells with slightly lignified walls. They are tallest at the base of the ovary, then gradually decrease in height until they are about the same height as the rest of the inner locular epidermal cells. This tissue probably functions in conducting water to the developing ovules (Pl. IV, fig. 30). A large cylinder of vascular tissue occupies the center of the ovary and the parenchyma tissue is noticeably thickened.

The number of chromosomes could not be definitely determined. They are numerous short rodlets. When massed on the metaphase plate the count closely approximates 20, but this number cannot be quoted with any great assurance. Numerous small and regular mitotic figures are found in all growing stages, but the chromosomes, when present, are always in clumps or groups. In the resting stage, the chromatin masses are numerous and pronouncedly basiphilic. The clumps are generally found just under the nuclear membrane, while within the nucleoplasm one or two large nucleoli are seen.

SUMMARY

The flower and seed of *Mollugo verticillata* might well be used for the microscopical study of the "typical flower."

The primorida of the ovules appear and gradually differentiate. The two integuments later form the seed coats. The megaspores behave in the usual manner and the large megaspore passes through the 2-4-8 cell stage.

The embryo sac then elongates rapidly, following the curve of the kidney-shaped ovule in its line of growth.

The stamens appear as evaginations at the base of the ovary, the sporogenous tissue giving rise to microspores and two rows of tapetal cells. The microspores divide into tetrads of spores, each of which finally contains a generative nucleus and a tube nucleus. The generative nucleus does not divide before the pollen grain fall on the stigma.

There are about 30 brownish seeds in an ovary. The fairly well-developed embryo occupies nearly three-fifths of the seed cavity, the balance being filled with starchy endosperm. Hence the seeds of *Mollugo verticillata* are intermediate between the extreme "albuminous" and "ex-albuminous" types.

The embryo contains much oil and protein. The outer seed coat and the outer row of nucellus cells at first perform a nutritive function, and later become heavily cutinized, forming protective coats for the delicate embryo. A gradual process of fat storage, emulsification and utilization has been traced as it occurs in the developing outer coat of the seed. Each large and regular sepal has three definite traces.

The gynoecium is composed of a three-loculed ovary which terminates in a short style and a tripartite stigma. Some of the cells of the inner epidermis of the carpels are greatly elongated and function probably as vascular tissue. The walls of these cells are lignified.

The chromosomal diploid count is estimated at twenty or less.

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EXPLANATION OF PLATES

PLATE I

Photomicrographs of ovules, etc., made from stained sections cut 8 or 10 μ thick.

FIG. 1. Section through carpel containing young ovules. Megaspore cells have differentiated as well as the inner integument. (× 470)

FIG. 2. A little later stage. The outer integument is forming and the megaspore cells have increased in size. (× 470)

FIG. 3. The egg-shaped megaspore mother cell perfectly formed at the apex of the young ovule. Its nucleus is large and the cytoplasm granular. (× 420)

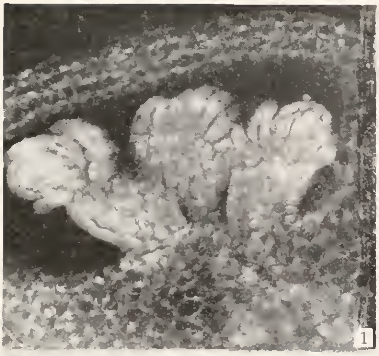
FIG. 4. Anaphase in one of the nuclei of a young embryo sac. (× 390)

FIG. 5. The embryo sac in the four-cell stage. Two nuclei are above, two below the large vacuole which is centrally located. The cells of the epidermis are gradually growing taller, but cytoplasmic secretion has not commenced. (× 380)

FIG. 6. An ovule containing a mature egg cell and degenerating antipodal cells. The walls of the epidermis have become somewhat cutinized and oil droplets and starch granules have appeared in the cytoplasm. The outer walls of the nucellus cells have also thickened. (× 360)

(Original magnifications given—must be corrected according to reduction of plates.)

PLATE I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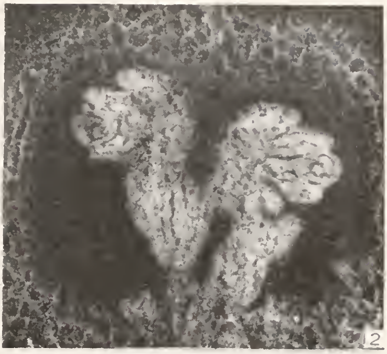
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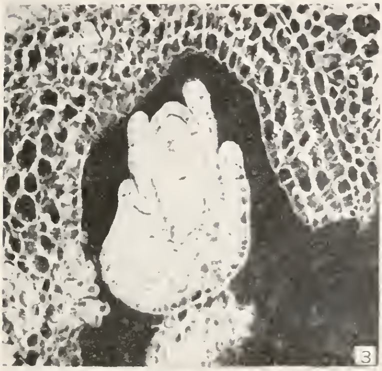
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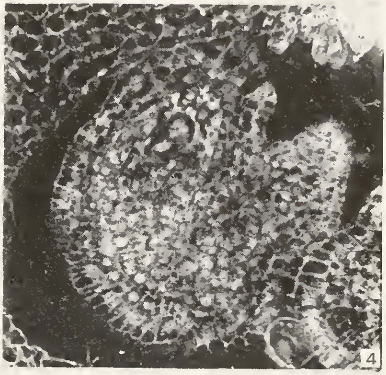
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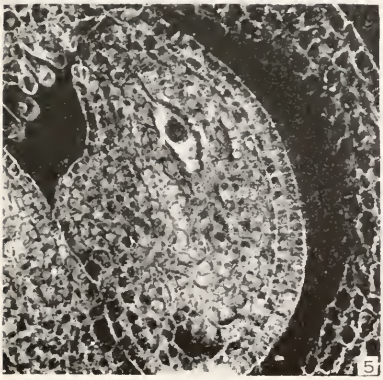
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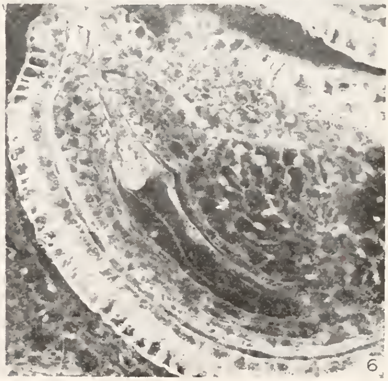
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PLATE II

FIG. 7. Section through part of ovary, showing seeds, seed coats, funiculus, micropyle, pathway of pollen tube, portions of embryo sacs, etc. (× 340)

FIG. 8. Female gamets attached at the antipodal end of the embryo sac. (× 360)

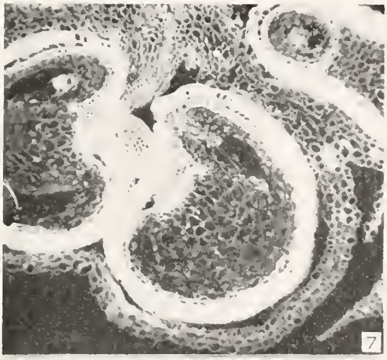
FIG. 9. Male and female pronuclei. (× 350)

FIG. 10. Embryo in the 2-cell stage of development. A large vacuole is present in the basal cell. (× 360)

FIG. 11. Cross-section of seed, showing several nuclei in the wall of the embryo sac. From a study of the serial sections it is probable that the nucleus in the central constricted region of the sac is the endosperm nucleus. (× 610)

FIG. 12. Young embryo buried deep in the nucleus. The micropyle and the pathway of the pollen tube show. (× 470)

PLATE II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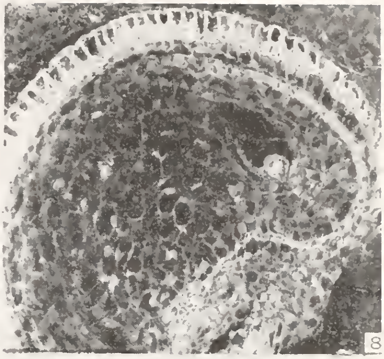
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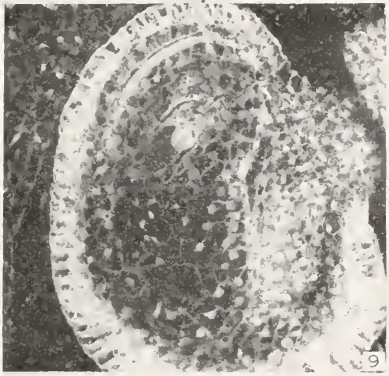
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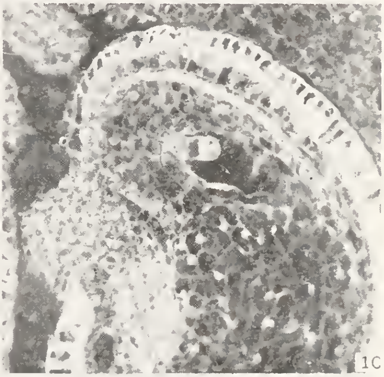
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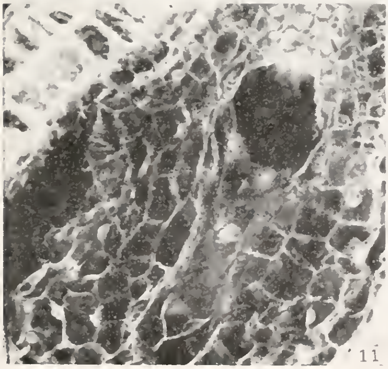
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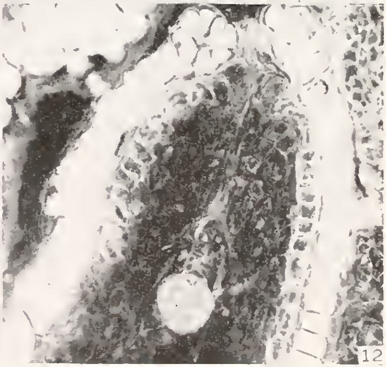
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PLATE III

FIG. 13. Primordium of stamen, before differentiation of sporogenous tissue. (× 480)

FIG. 14. Longitudinal section through locule of anther containing young microspore mother cells, surrounded by layers of tapetum. (× 130)

FIG. 15. Loculi of anther containing tetrads of spores. (× 270)

FIG. 16. x-section of mature anther. Pollen grains contain the generative and tube nuclei. The tapetum is broken down and degenerate. (× 300)

FIG. 17. Highly magnified view of cross sections of seeds. The brittle testa tends to break away from the underlying tissue when the seeds are cut. (× 160)

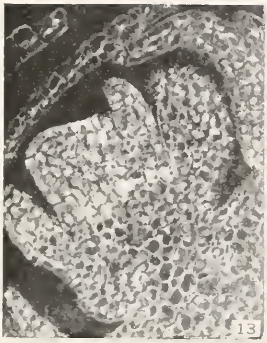
FIG. 18. Tangential section through the upper part of a flower, showing the radial thickenings in the endothecium of the anther wall. (× 130)

FIG. 19. Longitudinal sections through the seeds and ovary (sections cut about 25 μ). The relation of the embryo and endosperm is shown. (× 60)

FIG. 20. Young embryo removed from the seed. The cotyledons, plumule and radicle are shown. Tissue differentiation has commenced. (× 30)

FIG. 21. Seed from Mollugo in which part of the brittle testa has been removed. The cotyledons of the young embryo extend from the seed. The micropylar evagination is to one side of the short funiculus. (× 45)

PLATE III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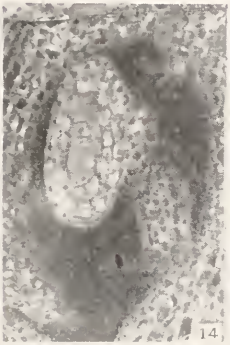
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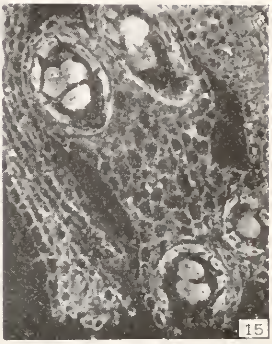
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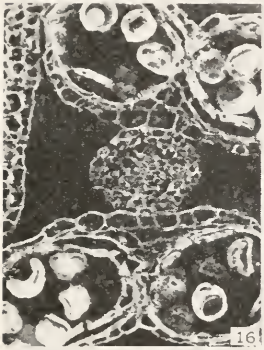
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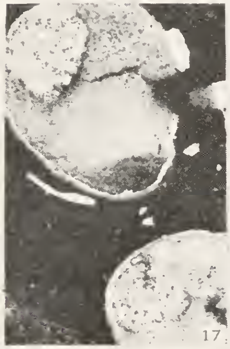
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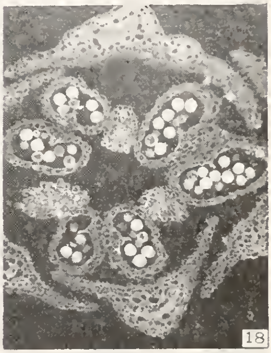
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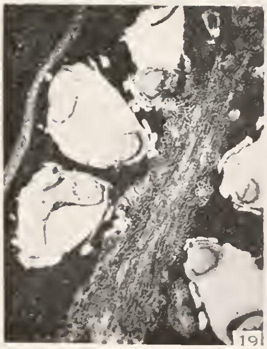
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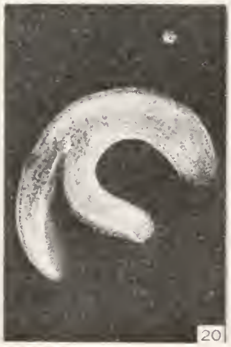
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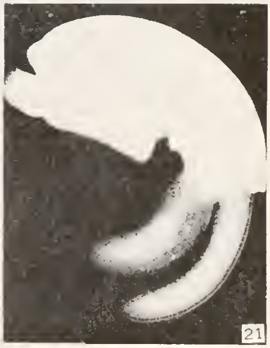
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PLATE IV

FIG. 22. As emulsification continues, the starch granules that remain in the cells of the outer seed coat aggregate at the top of the elongated cells. The nucleus of the protoplast has disappeared and the cells seem to be merely storage units. The walls, however, are gradually hardening, and the cuticular layer appears. (× 810)

FIG. 23. Vascular bundle in a cross section of the funiculus. (× 380)

FIG. 24. A later stage, when the fat content of the cells are emulsified and fill the cell cavity. There is less cell-content in the cells near the micropyle than in those at the opposite end of the seed. (× 240)

FIG. 25. Highly magnified integuments of ovule, just after cutinization of cell walls and secretory activity commences. (× 550)

FIG. 26. Highly magnified parenchyma cells showing the numerous and large plastids. In many of these several centers of starch formation can be distinguished in the individual plastid. (× 760)

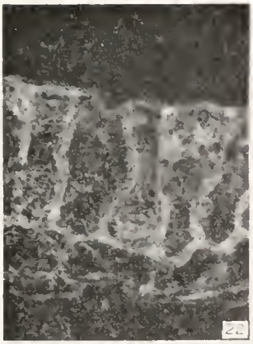
FIG. 27. Cross sections of seeds, showing the characteristic brittle testa of the mature seed. The cell contents have disappeared and the cuticular layer is heavy and continuous. (× 520)

FIG. 28. x-section through trace of sepal. The parenchyma tissue contains much starch, each border parenchyma cell having 8 or 10 large amyloplasts in the cytoplasm. The walls of the epidermis are cutinized. (× 540)

FIG. 29. x-section through the tip of a seed, showing the cuticular layer, the cells of the outer seed coat and the thin-walled cells that form the inner seed coat. (× 540)

FIG. 30. Tall columnar cells lining the inner wall of the base of the carpel. The walls of these cells are slightly lignified. (× 65)

PLATE IV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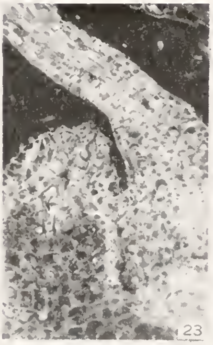
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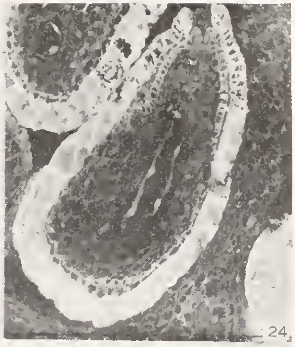
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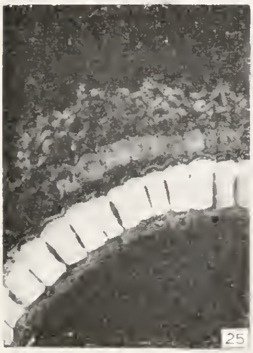
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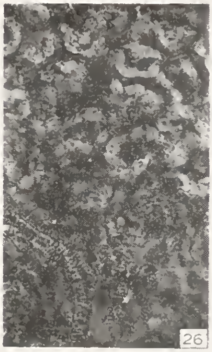
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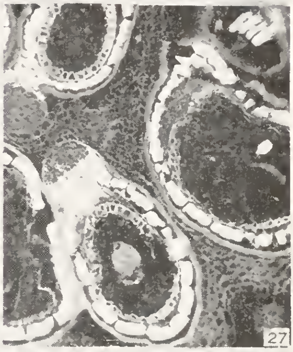
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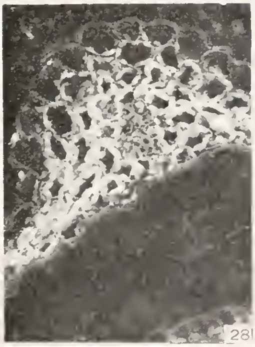
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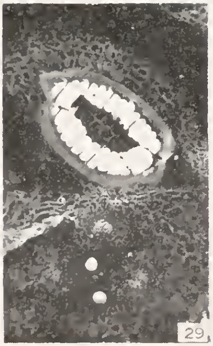
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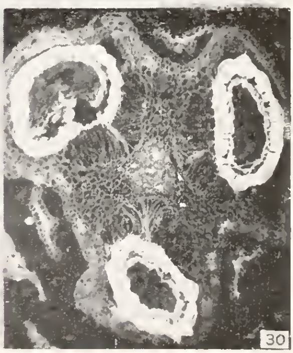
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Comparative Anatomical Research Within the Genus Lonicera

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ABSTRACT: The results obtained from a detailed anatomical and histological study of fifteen species of Lonicera are summarized.

The anatomy of one- and two-year stems of the various species has been recorded and a comparison made of the features characteristic of the species studied. Considerable differences were found in the stems in the primary cortex, pericyclic hard bast, secondary hard bast, time of development and number of rings of peridermal tissue in the two years' growth. Differences in the leaf were in the amount and distribution of trichomes of the leaf epidermis, presence or absence of glands, shape of leaf epidermal cells, shape of leaf tip, margin, midrib and petiole sections.

INTRODUCTION

PLANTS are usually classified with reference to their gross morphological features, a rational and most convenient method, but the finer histological structures also have taxonomic values and are especially useful in clarifying doubtful cases; furthermore, a comparative study of them reveals their relatively stable and mutable features and ecological adaptations. In my work with fifteen species of Lonicera sufficient anatomical differences have been observed to enable me, by various combinations of these, to develop keys for classification of the various species.

The Caprifoliaceae of which the genus Lonicera is a part is made up of thirteen genera: Sambucus, Viburnum, Symphoricarpus, Dipelta, Abelia, Linnaea, Kolkwitzia, Diervilla, Leycesteria, and about 400 species found chiefly in the North Temperate zone, and a few on the mountains in the Tropics and in the Southern Hemisphere. Within the genus Lonicera there are more than 100 species distributed in nearly all regions of the Northern Hemisphere, but most frequent in the Himalayas and Eastern Asia. About 100 species have been introduced into cultivation, grown for landscape effects as well as for their attractive flowers and fruits. The genus Lonicera includes shrubs that are rarely half-evergreen or evergreen and sometimes tree-like or climbing.

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* This work was carried out in the Botany Department of the University of Kansas under the direction of Prof. W. C. Stevens. The writer desires to make his appreciative acknowledgment to Professor Stevens for his help and encouragement during the preparation of the work here presented.

Of the fifteen species used in making a comparative study of the genus Lonicera the species *L. japonica*, *L. tatarica*, *L. bella*, *L. fragrantissima*, *L. sempervirens* and *L. Morrowii* were found in the vicinity of Lawrence, Kan., grown as ornamental shrubs, while species *L. demissa*, *L. Thibetica*, *L. Henryii*, *L. Webbiana*, *L. Spinosa Alberti*, *L. coerulea graciliflora*, *L. deflexicalyx xerocalyx*, *L. involucrata* and *L. tatarica siberica* were received from the Arnold arboretum.

The species which were found around Lawrence, Kan., were accessible at the beginning of my study and were collected in June and during the first part of July. The material sent from the Arnold arboretum was cut during August and shipped to Lawrence, Kan., preserved in a solution of formalin. In comparing tissues within the various stems, such as those of the periderm and of the primary cortex and pericycle, it must be granted that certain differences no doubt have occurred due to the month interval in time of cutting.

GEOGRAPHICAL DISTRIBUTION AND INTRODUCTION INTO CULTIVATION

L. Thibetica. Introduced into cultivation about 1897 from Western China.

L. Coerulea graciliflora. There is considerable variation within the species coerulea of which graciliflora is a variety. The species has long been in cultivation.

L. fragrantissima. Introduced into cultivation about 1845 from Eastern China.

L. involucrata. Found from Quebec to Alaska and in the Rockies south to Mexico. Introduced about 1880.

L. tatarica. Introduced into cultivation in 1752; native from southern Russia to Turkestan.

L. tatarica siberica. As above.

L. demissa. This species was found in Japan about the year 1914.

L. deflexicalyx xerocalyx. Found in southwestern China and introduced into cultivation about 1915.

L. japonica. This species has become somewhat naturalized in the eastern part of the United States; introduced from Eastern Asia about 1806.

L. Morrowii. Found in Japan in 1875.

L. Henryii. Introduced into cultivation about 1908 from western China.

L. Webbiana. First discovered in Southeastern Europe and in the Himalayas. Introduced about 1885.

L. sempervirens. Found in 1656; from Florida, west to Nebraska and Texas.

L. bella. Introduced sometime before 1878. This species is a hybird of Morrowii and *L. tatarica.*

L. Spinosa Alberti. Introduced from Turkestan about 1880.

NATURE OF PUBLISHED ANATOMICAL RESEARCH

Some work has been done on the anatomy of the genus Lonicera, mostly before 1900; summarized by Solereder ('08). Outstanding anatomical feature considered characteristic of the genus by Solereder are as follows:

1. Lack of specific type of stoma.
2. Occurrence of glandular hairs.
3. Medullary rays mostly narrow.
4. Secondary hard bast present in almost all members of the order.
5. Stone cells absent in the cortex.
6. Tendency towards the formation of scalariform perforations in the vessels.

Also, Solereder reports that the pericyclic development of cork does not occur in all Lonicers. Cork cells generally have wide cell cavities with thick or thin walls. The pericycle in most all cases contains hard-bast fibers, either forming rings or in groups.

Work on four species of the genus has been done by Dr. Ludwig Linsbauer ('95). These species were *L. glauca* Hill (*parviflora* Lam.), *L. japonica, L. nummularifolia* and *L. tometella.* Linsbauer found that *L. japonica* has two kinds of trichomes: large, single-celled hairs and hairs consisting usually of a three-celled stalk surmounted by a glandular head. The former type grows from elevations formed by groups of four to five cells of the collenchymatous hypoderm. He found also that the primary hard-bast fibers have large cavities and thin walls and form a closed ring.

Vesque (85) gave some of the distinguishing features of the Caprifoliaceae as being: Clothing hairs unicellular, cylindrical, sharp pointed, thickened, smooth or more frequently with pearlike projections or spiral striae; capitate hairs uniseriate with a multicellular head, rarely transformed into clothing hairs by hypertrophy of the cells of the head; guard cells surrounded by several cells irregularly disposed; crystals simple, clinorhombic, sometimes with concave faces, or clustered in aggregate crystals, rarely (Sambucus) pulverulent and composed of angular fragments, or wanting.

Joseph Mueller ('82) discusses the family, dividing it into two natural subdivisions by use of the structure of the bark.

Paul Oscar Michael ('85) investigated the central axis of the stems of a number of the species.

Hesselbarth ('79) summarizes work done by Michael and Schulz on the central axis and medullary rays.

Eugene Grignon ('84) has gone into the anatomy of the Caprifoliaceae in general, working with the petiole, leaf blade, stem, and root of various of the species.

H. H. Douliot ('89) has made a study of the periderm formation in a large group of plants, classifying the species according to the origin of their periderm. He speaks of all the species of Lonicera which he has studied as having periderm formation in the pericycle.

Rehder ('27) gives detailed description of the external features of the species of Lonicera.

Dr. Carl Fritsch ('91) goes into detail concerning the anatomy of the Caprifoliaceae, also giving consideration to the origin of the various species.

COMPARISON OF ANATOMICAL FEATURES

To keep this comparative study as uniform as possible the material for sectioning has been taken from corresponding parts of the plant in each of the species. For the study of the leaves, average-sized ones were taken and the venation was studied at the tip of the leaf. Margins and midribs were sectioned from portions of the leaf about midway in the extent of the leaf blade. Stem sections have been made within the second internode from the base of the current year's growth in length and from the preceding year's growth within the second internode. Only in species where early borke formation has occurred at the second internode has this rule been varied, taking sections from nearer the apex in order to determine the nature of the tissues that had been sloughed off. Very early sloughing of borke is common to the majority of the species within this genus, and for this reason various methods have been used in the attempt to get thin sections which would retain their outer tissues.

ONE- AND TWO-YEAR STEMS

In the study of the anatomy of one- and two-year stems of the various species certain features have been found which are characteristic of the stems in general. These features are as follows, proceeding from the outside to the center of the stem:

A. The bark.
  1. Trichomes occur in a majority of the species.
  2. A collenchymatous hypoderm, one to four cell rows broad immediately below the epidermis.
  3. Primary cortex narrow, becoming broken down and discolored early.
  4. A continuous cylinder of primary hard-bast fibers developing within the pericycle.
  5. Secondary hard-bast within the phloem of most species.
  6. Pericyclic development of cork in one-year stems.
  7. Borke formation occurring early in all species.

B. The wood.
  8. Occurrence of numerous wood fibers, radially arranged.
  9. Tracheal elements with scalariform perforated endings.
  10. Tracheids and xylem parenchyma sparce.
  11. Secondary medullary rays narrow, alternating with two to five radial groups of xylem elements.

C. The pith.
  12. Pith cylinder broken down, outer cells used as a storage tissue.

The above anatomical features are as found common to the species studied, although certain exceptions and variations occur. Therefore, it is necessary to discuss further the prominent features listed, bringing forth exceptions and variations when found.

Trichomes are found in the stem epidermis of the following species: *L. spinosa Alberti, L. japonica, L. coerulea graciliflora, L. bella, L. Morrowii, L. deflexicalyx xerocalyx* and *L. demissa,* being unicellular, cylindrical, sharp-pointed clothing hairs (Pl. VIII). In all these species there is considerable variation in size of the trichomes, although not of taxonomic value. The trichomes range from the short, blunt, inconspicuous hairs which average .08 mm. in length on stems of *L. spinosa Alberti* to the more conspicuous hairs averaging .51 mm. in length on the stems of *L. japonica*. *L. Thibetica* has trichomes which are off type, being wavy and matted on the stem (Pl. VIII, fig. 35). No glandular hairs were found on any of the stems. Dr. Ludwig Linsbauer (1895), however, speaks of both types as occurring on the epidermis of *L. japonica*. No trichomes are found on the stem of the following species and varieties: *L. sempervirens, L. tatarica, L. tatarica siberica, L. Henryii, L. involucrata* and *L. Webbiana.*

When comparing the nature and development of the primary cortex as found within the various species, we find a fairly uniform situation; however, there are slight variations, as well as some marked exceptions to the characteristic features of the majority of the species.

Those having a relatively narrow primary cortex are: *L. Thibetica*, *L. coerulea graciliflora*, *L. tatarica siberica*, *L. Henryii*, *L. Webbiana*, *L. japonica*, *L. Morrowii*, *L. involucrata*, *L. demissa* and *L. bella* (Pl. VII). *L. spinosa Alberti* at the second internode has sloughed off its primary cortex; however, in sections made near to the growing apex the cortex is seen to be narrow and would be included in the above list. Within this group the average breadth of the primary cortex is .04 mm. and the cortical parenchyma in each case has become badly crushed and discolored. *L. demissa* and *L. tatarica siberica* by August of the first season's growth have only thin shreds of their primary cortex remaining, due to the periderm formation.

L. sempervirens, *L. fragrantissima*, *L. tatarica* and *L. deflexicalyx xerocalyx* have their primary cortex relatively well developed and remaining nearly intact, with very little discoloration. In *L. deflexicalyx xerocalyx* the cortical parenchyma shows definite tangential elongation, but is still intact. The average breath of the cortex of these species is approximately .12 mm.; however, the cortex of *L. sempervirens* reaches .2 mm. in breadth.

The development of a continuous cylinder of primary hard-bast fibers within the pericycle is a most outstanding feature of the fifteen species studied. This tissue occurs without exception in the pericycle of all the species, although there are variations in the breadth of the zone, number of cell rows of which it is composed, and size of the fiber cavities. Slight variations are also found in the average thickness of the fiber walls in the various species.

Macerations were made of all the species, in order that the length and full appearance of the primary hard-bast fibers could be determined. In sections macerated, which were always over 15 mm. in length, the exact length of the fibers could not be determined. Only in one case was there a fiber of the primary hard bast found that measured less than 15 mm. in length, and this was in a maceration of *L. fragrantissima;* here I found one which was approximately .9 mm. long. The fibers of all the species were straight and stafflike, tapering to a blunt ending. No pits were seen in their walls.

In species *L. fragrantissima*, *L. tatarica siberica*, *L. deflexicalyx* *xerocalyx, L. Webbiana, L. bella, L. coerulea graciliflora* and *L. demissa* the primary hard-bast cylinder as seen in cross section is generally composed of from two to three fiber rows; however, there are slight variations in the breadth of the zones, due to the size and compactness of the fibers. Average cavity diameter of the hard-bast fibers found in these species ranges from .02 mm. in *L. Webbiana* to .029 mm. in *L. tatarica siberica* (Pl. VI, figs. 1, 7). Only slight variation in thickness of the walls of the primary hard-bast fibers is found within these species. Fibers of *L. deflexicalyx xerocalyx* have walls approximately .012 mm. thick, while the remaining species have fiber walls averaging .0065 mm. in thickness.

The primary hard-bast cylinders of *L. Morrowii* and *L. involucrata* are relatively narrow (Pl. VI, figs. 8, 11). The zone is approximately .04 mm. broad in both species. In *L. Morrowii* the fibers are smaller and less compact than in involucrata.

L. Henryii and *L. japonica* both have cylinders of primary hard bast not over two fiber rows broad; however, this zone is unusually prominent in the cross section of both species, due to the size of the bast fibers (Pl. VI, figs. 9, 13). In *L. Henryii* the zone is approximately .13 mm. broad and in *L. japonica* .04 mm. broad, the difference being due to the cavity diameters. The average cross diameter of the bast fibers of *L. Henryii* is .07 mm., while that of *L. japonica* is .021 mm. The walls of the primary hard-bast fibers of both species are thick, being approximately .013 mm. in *L. japonica* and .016 mm. in *L. Henryii.*

Species *L. sempervirens, L. tatarica* and *L. Thibetica* all have well-developed primary hard-bast cylinders. The zone in *L. tatarica* is very prominent in cross sections (Pl. VI, fig. 5), being composed of fibers uniform in size and relatively thick-walled, and from three to four rows in breadth. In contrast, the primary hard-bast cylinder of *sempervirens* is composed of fibers very unequal in cross diameter and relatively thin-walled, and is from five to six rows broad (Pl. VI, fig. 2). *L. Thibetica* has a cylinder of hard bast in the pericycle which is unusually well developed, being compact and from four to five fiber rows broad. The fibers are uniform in size and shape, averaging .03 mm. in cross diameter (Pl. VI, fig. 12).

The formation of secondary hard-bast fibers occurs in the majority of the species within the phloem area of the second year's growth and often within the phloem of the first year. The fibers are seldom in a continous cylinder, as those of the primary hard bast are, but form a broken cylinder, often interrupted by the xylem rays extending through them. In some species, such as *L. demissa, L. fragrantissima* and *L. deflexicalyx xerocalyx,* in the second year phloem there are two and three centripetal layers of the secondary hard-bast fibers developed within the one-season's growth. This occurs also in the first-year phloem of *L. demissa.*

Species which have secondary hard bast occurring in both first- and second-year phloem are *L. demissa, L. fragrantissima, L. deflexicalyx xerocalyx,* and *L. involucrata.* Those with secondary hard bast found only in the second-year phloem are, *L. bella, L. Morrowii, L. japonica* and *L. tatarica siberica.* No secondary hard-bast fibers were found in either first- or second-year phloem in the following species: *L. sempervirens, L. tatarica, L. Thibetica, L. spinosa Alberti.*

There is very little difference in the size of the fibers developed within the phloem of the various species. The walls are relatively thick, usually .01 mm. from cavity to cavity, and the cavities average .005 mm. in cross diameter. In the first-year phloem of *L. demissa* two concentric cylinders of secondary hard-bast fibers occur, the outer cylinder being composed of average-sized fibers, while the inner cylinder has fibers with cavities approximately .01 mm. in cross diameter and walls approximately .005 mm. thick. Then in *L. Morrowii* the cavities of the fibers average .015 mm. in cross diameter with walls approximately .01 mm. thick.

The secondary hard-bast fibers (in contrast to the primary hard-bast fibers) as seen in macerated and longitudinal sections resemble the wood fibers. Walls of the fibers are not pitted. In every case the fibers have given a good lignin reaction.

Pericyclic development of cork in one-year growth and additional borke formation in two-years growth has been found to be typical of all the species. The phellogen of one-year stems is a band of pericyclic cells situated immediately beneath the primary hard-bast fibers and in front of the primary phloem. Later formation occurs as a result of phellogen layers developing within the secondary phloem.

Development of the pericyclic cylinder of cork occurs earlier in some species than others. Of the nine species cut during August, *L. spinosa Alberti, L. Webbiana* (Pl. V, figs. 2, 5), and *L. Henryii* show pericyclic cork well advanced, it being at that time five to seven rows broad and very prominent in cross section. In *L. spinosa Alberti* all tissues outside the cork formation have been sloughed off from stems at the second internode of the current year's growth in elongation. *L. demissa*, *L. coerulea graciliflora*, and *L. tatarica siberica* have a pericyclic cylinder of cork approximately three or four rows broad, while in species *L. involucrata* and *L. Thibetica* the cylinder is usually two rows broad. *L. deflexicalyx xerocalyx* has very little pericyclic cork developed by August in the current year's growth (Pl. V, fig. 1). In general, species *L. sempervirens*, *L. bella*, *L. japonica*, *L. fragrantissima*, *L. tatarica* and *L. Morrowii* cut during June and the first part of July show a less amount of cork than is found in the above species gathered in August, as one would expect, due to the month difference in time of cutting. *L. bella* has from three to four rows of pericyclic cork developed, but *L. fragrantissima*, *L. japonica* and *L. Morrowii* have approximately two rows. *L. sempervirens* shows very little pericyclic development of cork at this period of its growth, the cork occurring in places only one row broad.

The cork cells of all species are comparatively uniform in size and shape. Average cork cells of the various species are approximately .03 mm. in cross diameter and .08 mm. in length. The cork cells in all the species excepting *L. Webbiana* have relatively thin walls; in *L. Webbiana* they are noticeably thickened.

The most noticeable feature concerning the pith cylinder is the arrangement of the pith cells and the fact that in most of the species during the first year's growth the cylinder breaks down at the center. As to the arrangement of the cells, it is common to find small-cavitied, relatively heavy-walled pith cells lying next to the vascular ring and serving as a storage tissue. The cells nearer the center are larger cavitied and thinner walled. Walls of these cells in all species are pitted.

No outstanding variations are found in comparing the xylem areas of the various species. In cross sections the elements are seen to be arranged in radial groups of two to five rows wide alternating with relatively prominent xylem rays. No primary medullary rays occur, due to the procambium having developed in a continuous cylinder. The tracheal tubes are well scattered and of various sizes, being always more concentrated in the early growth of the annual ring. The protoxylem points are not prominent and usually indent the pith cylinder very little.

In the various species the wood fibers vary considerably in length within a single macerated mount; however, the average size is generally .6 mm. in length and .02 mm. in width. Their walls show elliptic, inclined pits and are relatively thickened. In the macerations of the stems of the species the wood fibers were always the more prominent xylem element.

The tracheal tubes are composed of elements generally not over .4 mm. in length as an average of all the species. They are seen to lie end to end, bluntly tapering and slightly overlapping, with scalariform perforations in their end walls. This characteristic is typical of all the species, although within the xylem area of the same species, tracheal elements having their end walls nearly or entirely dissolved out are found. The latter type is more often found in the older growth of the stem. Dr. Ludwig Linsbauer ('95) recognized this feature in species of Lonicera when he said, "The cross walls of the tracheal tubes are elliptical with scalariform perforations; complete breaking down of the cross walls is not common in the one-year-old stems; this condition is more characteristic of the later additions of the annual rings." The walls of the elements have elliptic, reticulately arranged pits. The size of the tracheal-tube cavities in cross diameter varies within the fifteen species; the average being approximately .04 mm. *L. japonica* and *L. Henryii* have tracheal tubes often .06 mm. in cross diameter. Hesselbarth ('79) speaks of *L. japonica* as having tracheal tubes often .1 mm. in cross diameter.

Tracheids and xylem parenchyma are sparse in all the species studied. Those tracheids observed in macerated material were fiber tracheids averaging .6 mm. in length and .025 mm. in cross diameter. Their walls were densely marked with reticulately arranged pits. The xylem parenchyma cells always had relatively thin walls marked with small pits, and average .07 mm. in length and .02 mm. in cross diameter.

The xylem rays as seen in tangential sections can be described by a single type which is characteristic of those seen in all the species. This type is brought out in a dissertation by Michael ('85) when he attempted to make use of the medullary rays in a new way in taxonomy. He set up for the Caprifoliaceae a principal type which could be found in all genera but Sambucus. In this type the shorter cells occupy the center of the ray, with longer cells above and below them, while above and below these longer cells the longest cells were to be found. This type has been found in all the fifteen species, the rays varying only in number of cell rows across the tangential and longitudinal diameters. Cells of the xylem rays are strongly pitted and usually have stored food within them.

THE LEAVES

A study of the leaves of the various species show clothing hairs and some glandular hairs occurring in general upon both surfaces of the leaf, but principally on the lower surface. The typical clothing hairs are represented by a cell with thickened walls, strongly developed in length, diminishing in diameter from base to summit and finally terminating in a very sharp point. Trichomes of this type are found in both epidermises of species *L. japonica, L. bella, L. Morrowii, L. deflexicalyx xerocalyx, L. Webbiana, L. demissa, L. coerulea graciliflora, L. involucrata, L. Henryii* and *L. tatarica siberica* (Pl. VIII). Among these species variations of the trichomes are found, such as the occurrence sometimes of ring-like markings and thickenings in the walls. Some of the species have trichomes well scattered over the leaf blade, while in others, such as *L. tatarica siberica* and *L. coerulea graciliflora,* the trichomes are found chiefly along the margin and midrib, being but sparsely scattered over the leaf blade.

Two species, *L. sempervirens* and *L. Thibetica,* have trichomes only on the lower surface of the leaf. Trichomes found on *L. Thibetica* are off-type, being slender and wavy (Pl. VIII, fig. 36). The leaves of *L. fragrantissima, L. tatarica* and *L. spinosa Alberti* have no trichomes borne on either of the leaf's surfaces.

Glandular hairs were seen on the leaf blade of four species, *L. bella, L. demissa* (Pl. VIII, fig. 66), *L. involucrata* (Pl. VIII, fig. 8), and *L. Morrowii* (Pl. VIII, fig. 48). These hairs are borne mostly along the midribs and veins. They have a multicellular head surmounting a one- or two-celled stalk.

Cells of the two epidermises in the leaves seldom have the same cavity diameter, the upper epidermal cells being the larger. The epidermal lateral walls of some of the species are pitted, this being very noticeable in the upper epidermis of *L. japonica* (Pl. VIII, fig. 5). More or less undulation of the lateral walls in the lower epidermis is typical of the fifteen species. The lower epidermises of *L. Morrowii, L. japonica* and *L. bella* are noticeably undulated (Pl. VIII, figs. 45, 6, 54).

L. Henryii, in the tests made for a cutinized outer wall of the epidermal cells, is the only leaf to show all of the outer wall in this condition; however, a thin cuticle is found covering both epidermises of all the species. In *L. Henryii* the upper epidermal cells project in peaks at the surface.

Stomata occur only in the lower epidermis, the guard cells being surrounded by a varying number of epidermal cells exhibiting no regular arrangement or special shape; however, considerable variation has been found in the number of stomata occurring per sp. mm. of leaf surface. Among the species this number ranges from .40 per sq. mm. in *L. bella* to 528 per sq. mm. in *L. fragrantissima.*

The structure of the mesophyll remains relatively stable throughout the fifteen species, being composed of from one to two rows of palisade cells above and irregularly arranged spongy mesophyll cells below. Variations occur in the number of palisade cells in the upper layer per sq. mm., ranging from 2,500 per sq. mm. in *L. sempervirens* to 10,000 in *L. Thibetica.* Large cluster-crystals of calcium oxalate are commonly found in the mesophyll of the various species, being unusually large in *L. Henryii* and occurring chiefly in the palisade row. A glucoside is found in patches immediately below the epidermises in *L. demissa.*

There is considerable variation in the size and shape of the midribs among the fifteen species (Pl. VII). *L. spinosa Alberti* and *L. Thibetica* have midribs averaging .22 mm. in breadth and .26 mm. in thickness, while those of *L. involucrata* are approximately .97 mm. in breadth and .94 mm. in thickness; this contrast corresponds to the difference in the size of the leaves. Shapes of the midribs vary from V-shaped in *L. Thibetica* to elliptical and circular outlines in *L. bella* and *L. involucrata.* With these variations in general shape there are contrasts among the species as to the appearance of the upper surface of the midribs, the variation ranging from a definite V-shaped indentation to a convex upper surface.

The fundamental tissue of the midrib is principally composed of large, thin-walled parenchymatous cells; however, it is typical of all the species to have one or two rows of sclerotic cells beneath the lower epidermis in the position of a collenchymatous hypoderm. In *L. fragrantissima* there are five or six rows of this tissue composing nearly all of the fundamental tissue zone. *L. bella* has isolated sclerotic cells lying in close proximity to the vascular bundle; and the vascular bundles of *L. fragrantissima* and *L. cocrulea graciliflora* are nearly surrounded by a compact zone of hard-bast fibers. Species having midribs indented or concave on the upper surface seldom have the sclerotic cells beneath the upper epidermis; however, in those midribs having a convex upper surface, two to five rows are usually found.

The vascular system of the midribs vary in cross-sectional size and shape, depending upon the size of the midrib. In the smaller midribs the vascular bundle is elliptical, while in the larger midribs the bundles have the shape of a wide open arc.

The margins of the leaves vary from rounded to obtuse among the various species. In this respect the species are shown in Plate VI, figures 16-30.

Variations found in the structure of the petioles correspond with those discussed concerning the midrib. Some of the species, such as *L. bella, L. tatarica, L. Henryii* and *L. Webbiana,* have petioles lunate in general outline of the cross section, with the upper surface only slightly concave (Pl. VII, figs. 16, 10, 17, 1). The petioles of *L. fragrantissima* and *L. deflexicalyx xerocalyx* are kidney-shaped in cross section, while those of *L. japonica* and *L. sempervirens* are triangular, with the upper surface slightly convex (Pl. VII, figs. 5, 13, 11, 6). As was stated concerning the midribs, the petioles range in size from the smallest, found in *L. spinosa Alberti,* to the largest, found in *L. involucrata* (Pl. VII, figs. 4, 8).

The fundamental tissue is typically composed of large, circular, thin-walled parenchyma cells surrounding the vascular system and of one to two rows of sclerotic cells beneath the epidermis, having the position of a collenchymatous hypoderm; however, in the petiole of *L. fragrantissima* nearly the whole zone of fundamental tissue is sclerotic. The projected petiole margins of *L. sempervirens* and *L. involucrata* have sclerotic cells within them.

A majority of the vascular systems are in a continuous wide-open arc, although in *L. sempervirens* and *L. coerulea graciliflora* isolated bundles compose the vascular arc and in *L. involucrata* the arc is three divided (Pl. VII, fig. 8).

In conclusion, the following structurals have been found to be characteristic of the leaves among the fifteen species.

A. Leaf blade.
  1. Simple clothing hairs on a majority of the species, chiefly on the lower surface.
  2. Lateral walls of the lower epidermal cells more or less undulated.
  3. Stomata occurring only on the lower surface.
  4. Clusters of sclerotic cells in the margins of the leaves.

B. Midrib.
  5. One to two rows of sclerotic cells beneath the lower epidermis and two to six rows beneath the upper epidermis, having the position of a collenchymatous hypoderm.
  6. Calcium oxalata crystals within the cavities of the relatively large, thin-walled parenchyma cells.
  7. Vascular system in the shape of a wide-open arc.

C. Petiole.

8. One to three cell rows of sclerotic cells having the position of a collenchymatous hypoderm.
9. Fundamental tissue large cavitied and thin walled, often with large cluster crystals of calcium oxalate.
10. Vascular arc continuous, seldom in lobes.

ANATOMICAL KEY—MIDRIBS

Using shape of midrib, trichomes, vascular bundle, hard-bast fibers and stomata.

I. Midribs with distinctly V-shaped indentation on the upper surface.
A. Vascular bundle elliptical to circular in cross section.
1. Midrib projecting in V-shaped fashion on the lower surface.
a. Leaf without trichomes.............................. *L. spinosa Alberti.*
b. Leaf with dense mass of wavy trichomes on the lower surface... *L. Thibetica.*
2. Midrib projecting roundedly on lower surface..................... *L. demissa.*
II. Midribs with concave upper surface.
A. Vascular bundle in a widely spread arc.
1. Midribs circular in cross section, with numerous small trichomes on the upper surface .... *L. involucrata.*
2. Midribs elliptical in cross section; with few trichomes. . *L. deflexicalyx xerocalyx.*
B. Vascular bundle elliptical in cross section.......................... *L. Morrowii.*
III. Midribs with convex upper surface.
A. Vascular bundle enclosed within a zone of hard-bast fibers....... *L. fragrantissima.*
B. Vascular bundle not enclosed within a zone of hard-bast fibers.
1. Midrib extending very little on either surface; elliptical in cross section .... *L. Henryii.*
2. Midrib decidedly projecting below; circular in cross section.
a. Leaf blade without trichomes................................ *L. tatarica.*
b. Leaf blade with trichomes sparsely scattered on the lower surface only .... *L. sempervirens.*
c. Leaf blade with trichomes on both surfaces.
(1) Approximately 272 stomata per sq. mm. of leaf surface.... *L. Webbiana.*
(2) Approximately 140 stomata per sq. mm. of leaf surface........ *L. bella.*
(3) Approximately 204 stomata per sq. mm. of leaf surface..... *L. japonica.*
3. Midrib decidedly projecting below, but more or less square in cross section .... *L. tatarica siberica.*
IV. Midrib with the upper surface even with the upper surface of the leaf blade.
L. coerulea graciliflora.

ANATOMICAL KEY—PETIOLES

Using shape and size of the petiole in cross section, vascular system and trichomes.

I. Upper surface of the petiole more or less concave.
A. Margins projecting.
1. Vascular system in three lobes or divisions.
a. Numerous trichomes on both surfaces.
(1) Only on the upper surface...................... *L. coerulea graciliflora.*
(2) Sparsely scattered over both surfaces..................... *L. demissa.*
2. Vascular system not lobed or divided.
a. Vascular system in the shape of an arc.
(1) Trichomes numerous on both surfaces.................... *L. Morrowii.*
(2) Trichomes few or none........................... *L. tatarica siberica.*
b. Vascular system elliptical, nearly circular in cross section. . *L. spinosa Alberti.*
B. Margins not projecting.
1. Vascular system in three lobes or divisions................. *L. fragrantissima.*
2. Vascular system not lobed or divided.
a. Isolated sclerotic cells in close proximity to the vascular bundle... *L. tatarica.*
(1) Trichomes scattered over the surface.......... *L. deflexicalyx xerocalyx.*
(2) Trichomes few, if any.
(a) Average petiole 1.35 mm. wide and 1.2 mm. thick..... *L. Webbiana.*
(b) Average petiole .97 mm. wide and .82 mm. thick........ *L. Henryii.*
(c) Average petiole .6 mm. wide and .47 mm. thick....... *L. Thibetica.*

- II. Upper surface of the petiole flat.
  - A. Margins projecting; petiole in cross section triangular.................*L. japonica.*
  - B. Margins not projecting; petiole in cross section semicircular...............*L. bella.*
- III. Upper surface of the petiole slightly convex, with the margins sharply projecting ....*L. sempervirens.*

ANATOMICAL KEY—STEMS

Key to stems using the presence or absence of trichomes, features of the primary cortex, together with the hard bast of the pericycle.

- I. Trichomes wanting.
  - A. Primary cortex many cell-rows broad.
    - a. Hard-bast fibers thin walled; cavities not exceeding .043 mm. in cross diameter ....*L. sempervirens.*
    - b. Hard-bast fibers moderately thick walled; cavities often .052 mm. in cross diameter ....*L. tatarica.*
  - B. Primary cortex narrow, having but few cell-rows.
    - a. Hard-bast fibers with cavities usually .05 mm. in cross diameter or greater.
      - 1. Fibers thin-walled, .01 mm. in thickness................*L. tatarica siberica.*
      - 2. Fibers thick-walled, .02 mm. in thickness......................*L. Henryii.*
    - b. Hard-bast fibers with cavities seldom over .03 mm. in cross diameter.
      - 1. Fiber ring mostly composed of one cell row.................*L. involucrata.*
      - 2. Fiber ring mostly composed of three cell rows................*L. Webbiana.*
- II. Trichomes present.
  - A. Trichomes short and inconspicuous.
    - a. Hard-bast fibers averaging .01 mm. in cross diameter........*L. spinosa Alberti.*
    - b. Hard-bast fibers averaging .025 mm. in cross diameter........*L. fragrantissima.*
  - B. Trichomes well developed and conspicuous.
    - a. Hard-bast ring narrow; usually not more than two cell rows broad.
      - 1. Fibers with walls approximately .013 mm. in thickness..........*L. japonica.*
      - 2. Fibers with walls approximately .01 mm. in thickness.
        - (a) Cavities of fibers seldom over .029 mm. in cross diameter. *L. coerulea graciliflora.*
        - (b) Cavities of fibers often over .04 mm. in cross diameter.........*L. bella.*
      - 3. Fibers with walls approximately .0065 mm. in thickness........*L. Morrowii.*
    - b. Hard-bast ring broad, usually from three to five cell rows broad.
      - 1. Primary cortex six to ten cell-rows broad...........*L. deflexicalyx xerocalyx.*
      - 2. Primary cortex three to five cell-rows broad.
        - (a) Bast ring mostly five cell-rows broad.....................*L. Thibetica.*
        - (b) Bast ring approximately three cell-rows broad.............*L. demissa.*

PLATE V

TYPICAL STEM CROSS SECTIONS (× 76)

FIG. 1. Stem section of *L. deflexicalyx xerocalyx* from the current year's growth.

FIG. 2. Stem section of *L. Webbiana* from the current year's growth.

FIG. 3. Stem section of *L. tatarica* from the current year's growth.

FIG. 4. Stem section of *L. deflexicalyx xerocalyx* from two-years growth.

FIG. 5. Stem section of *L. Webbiana* from two-years growth.

PLATE V

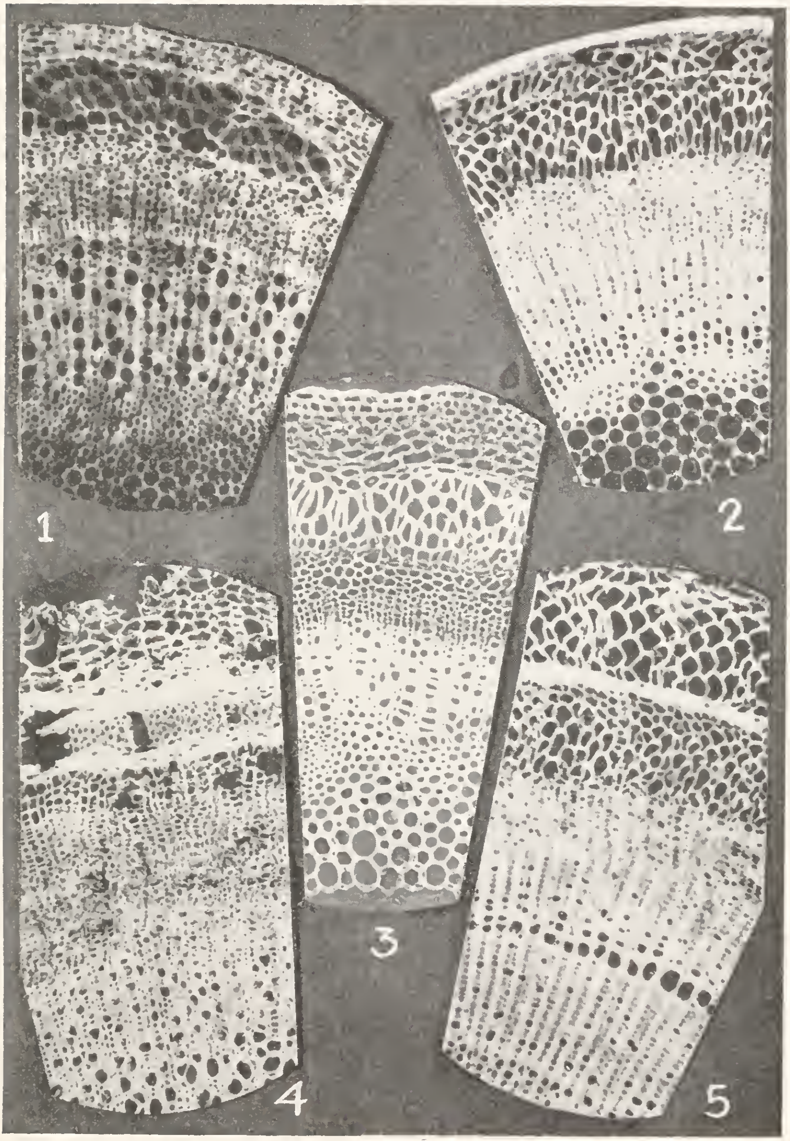


PLATE VI

Cross sections of the stem cortex and pericyclic hard bast and leaf margins (× 100).

STEM CORTEX AND PERICYCLIC HARD BAST

Fig. 1. *L. Webbiana.*
Fig. 2. *L. sempervirens.*
Fig. 3. *L. coerulea graciliflora.*
Fig. 4. *L. spinosa Alberti.*
Fig. 5. *L. tatarica.*
Fig. 6. *L. deflexicalyx xerocalyx.*
Fig. 7. *L. tatarica siberica.*
Fig. 8. *L. Morrowii.*
Fig. 9. *L. Henryii.*
Fig. 10. *L. bella.*
Fig. 11. *L. involucrata.*
Fig. 12. *L. Thibetica.*
Fig. 13. *L. japonica.*
Fig. 14. *L. fragrantissima.*
Fig. 15. *L. demissa.*

LEAF MARGINS

Fig. 16. *L. tatarica siberica.*
Fig. 17. *L. deflexicalyx xerocalyx.*
Fig. 18. *L. demissa.*
Fig. 19. *L. japonica.*
Fig. 20. *L. Henryii.*
Fig. 21. *L. involucrata.*
Fig. 22. *L. sempervirens.*
Fig. 23. *L. Webbiana.*
Fig. 24. *L. coerulea graciliflora.*
Fig. 25. *L. bella.*
Fig. 26. *L. Morrowii.*
Fig. 27. *L. spinosa Alberti.*
Fig. 28. *L. fragrantissima.*
Fig. 29. *L. tatarica.*
Fig. 30. *L. Thibetica.*

PLATE VI

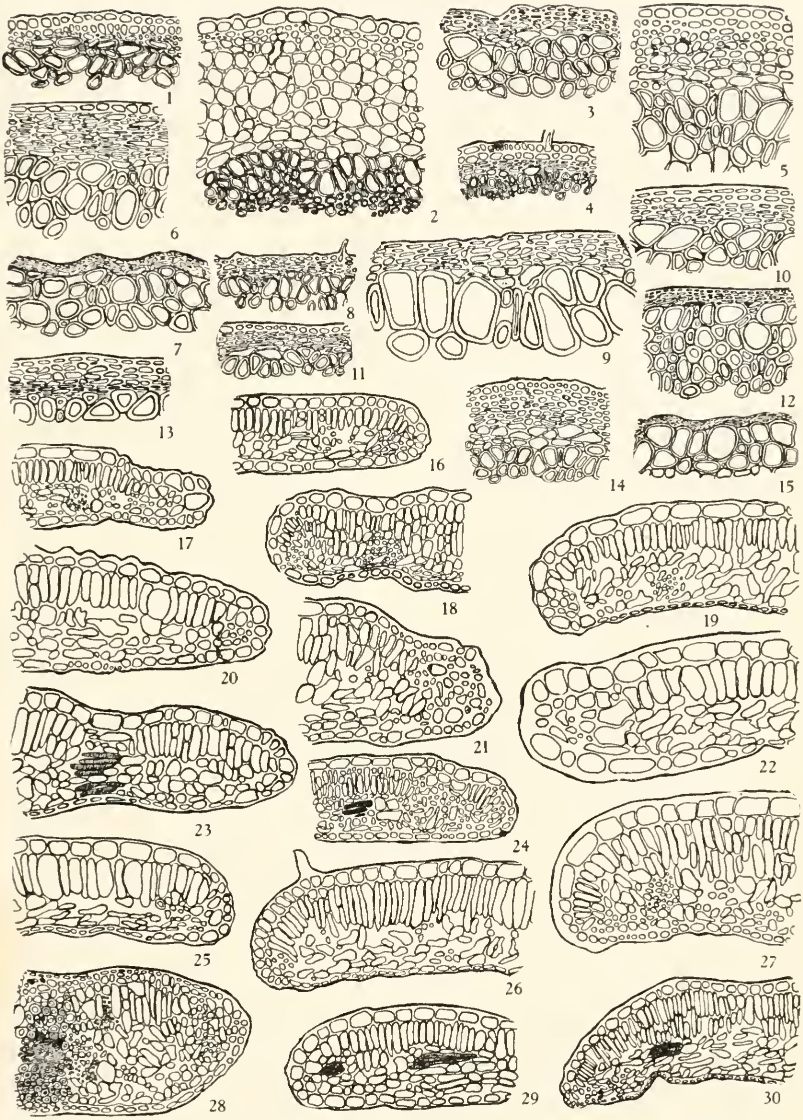


PLATE VII

Semidiagrammatic drawings of cross sections through the midrib (Figs. 1-14 and 16) × 20 and petioles (Figs. 15 and 17-30) × 18.

Fig. 1. *L. Webbiana.*
Fig. 2. *L. Thibetica.*
Fig. 3. *L. demissa.*
Fig. 4. *L. spinosa Alberti.*
Fig. 5. *L. fragrantissima.*
Fig. 6. *L. sempervirens.*
Fig. 7. *L. Henryii.*
Fig. 8. *L. involucrata.*
Fig. 9. *L. Morrowii.*
Fig. 10. *L. tatarica.*
Fig. 11. *L. japonica.*
Fig. 12. *L. coerulea graciliflora.*
Fig. 13. *L. deflexicalyx xerocalyx.*
Fig. 14. *L. tatarica siberica.*
Fig. 15. *L. Thibetica* (petiole).
Fig. 16. *L. bella* (midrib).
Fig. 17. *L. japonica.*
Fig. 18. *L. Morrowii.*
Fig. 19. *L. Webbiana.*
Fig. 20. *L. spinosa Alberti.*
Fig. 21. *L. tatarica.*
Fig. 22. *L. fragrantissima.*
Fig. 23. *L. involucrata.*
Fig. 24. *L. bella.*
Fig. 25. *L. sempervirens.*
Fig. 26. *L. deflexicalyx xerocalyx.*
Fig. 27. *L. Henryii.*
Fig. 28. *L. tatarica siberica.*
Fig. 29. *L. demissa.*
Fig. 30. *L. coerulea graciliflora.*

PLATE VII

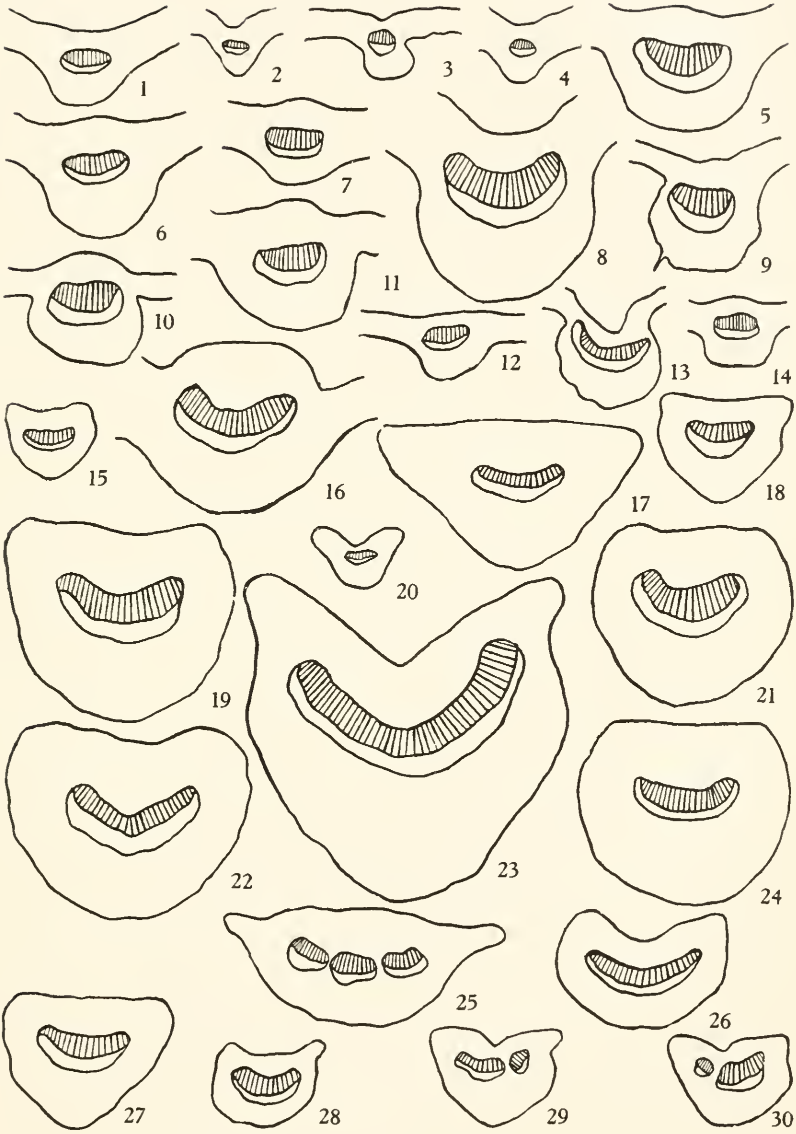


PLATE VIII

(See page 51)

Surface views of the stem and leaf epidermises, and trichomes. × 100.

FIG. 1. Lower leaf epidermis of *L. involucrata.*
FIG. 2. Stem epidermis of *L. involucrata.*
FIG. 3. Stem epidermis of *L. fragrantissima.*
FIG. 4. Lower leaf epidermis of *L. fragrantissima.*
FIG. 5. Upper leaf epidermis of *L. japonica.*
FIG. 6. Lower leaf epidermis of *L. japonica.*
FIG. 7. Upper leaf epidermis of *L. involucrata.*
FIG. 8. Glandular hair from the lower surface of a leaf of *L. involucrata.*
FIG. 9. Upper leaf epidermis of *L. fragrantissima.*
FIG. 10. Lower leaf epidermis of *L. sempervirens.*
FIG. 11. Stem trichome from *L. japonica.*
FIG. 12. Stem epidermis from *L. japonica.*
FIG. 13. Trichome from upper surface of the leaf of *L. japonica.*
FIG. 14. Trichome from the lower surface of a leaf of *L. involucrata.*
FIG. 15. Upper leaf epidermis of *L. sempervirens.*
FIG. 16. Leaf trichome from *L. sempervirens.*
FIG. 17. Stem epidermis of *L. sempervirens.*
FIG. 18. Trichome from the upper surface of a leaf of *L. involucrata.*
FIG. 19. Lower leaf epidermis from *L. Webbiana.*
FIG. 20. Stem epidermis from *L. tatarica.*
FIG. 21. Upper leaf epidermis from *L. tatarica.*
FIG. 22. Trichome from the lower surface of the leaf of *L. japonica.*
FIG. 23. Upper leaf epidermis of *L. Thibetica.*
FIG. 24. Stem epidermis from *L. Webbiana.*

PLATE VIII—CONTINUED

FIG. 25. Trichome from the upper surface of a leaf of *L. Webbiana.*
FIG. 26. Upper leaf epidermis of *L. Webbiana.*
FIG. 27. Lower leaf epidermis from *L. tatarica.*
FIG. 28. Stem trichome from *L. spinosa Alberti.*
FIG. 29. Stem epidermis of *L. Thibetica.*
FIG. 30. Lower leaf epidermis from *L. Webbiana.*
FIG. 31. Upper leaf epidermis from *L. deflexicalyx xerocalyx.*
FIG. 32. Trichome from upper surface of the leaf of *L. deflexicalyx xerocalyx.*
FIG. 33. Upper leaf epidermis from *L. spinosa Alberti.*
FIG. 34. Lower leaf epidermis from *L. spinosa Alberti.*
FIG. 35. Trichome from the stem of *L. Thibetica.*
FIG. 36. Trichome from the lower surface of the leaf of *L. Thibetica.*
FIG. 37. Upper leaf epidermis of *L. demissa.*
FIG. 38. Stem trichome from *L. deflexicalyx xerocalyx.*
FIG. 39. Stem epidermis from *L. deflexicalyx xerocalyx.*
FIG. 40. Upper leaf epidermis of *L. tatarica siberica.*
FIG. 41. Stem epidermis of *L. tatarica siberica.*
FIG. 42. Lower leaf epidermis of *L. tatarica siberica.*
FIG. 43. Upper leaf epidermis from *L. bella.*
FIG. 44. Stem trichome from *L. Morrowii.*
FIG. 45. Lower leaf epidermis of *L. Morrowii.*
FIG. 46. Trichome from the lower surface of the leaf of *L. deflexicalyx xerocalyx.*
FIG. 47. Leaf trichome from *L. tatarica siberica.*
FIG. 48. Glandular hair from the lower epidermis of *L. Morrowii.*

PLATE VIII—CONCLUDED

FIG. 49. Upper leaf epidermis from *L. Morrowii.*
FIG. 50. Stem epidermis of *L. coerulea graciliflora.*
FIG. 51. Trichome from the lower surface of a leaf of *L. coerulea graciliflora.*
FIG. 52. Lower leaf epidermis of *L. coerulea graciliflora.*
FIG. 53. Trichome from the lower surface of the leaf of *L. bella.*
FIG. 54. Lower leaf epidermis from *L. bella.*
FIG. 55. Stem epidermis from *L. bella.*
FIG. 56. Stem epidermis from *L. Morrowii.*
FIG. 57. Trichome from the upper surface of *L. coerulea graciliflora.*
FIG. 58. Stem trichome of *L. coerulea graciliflora.*
FIG. 59. Upper leaf epidermis from *L. coerulea graciliflora.*
FIG. 60. Stem trichome from *L. bella.*
FIG. 61. Trichome from upper surface of the leaf of *L. bella.*
FIG. 62. Trichome from the lower surface of the leaf of *L. Morrowii.*
FIG. 63. Lower leaf epidermis of *L. demissa.*
FIG. 64. Trichome from lower surface of a leaf of *L. demissa.*
FIG. 65. Stem epidermis of *L. demissa.*
FIG. 66. Glandular hair from lower surface of a leaf of *L. demissa.*
FIG. 67. Trichome from upper surface of a leaf of *L. demissa.*
FIG. 68. Trichome from stem of *L. demissa.*
FIG. 69. Upper leaf epidermis from *L. Henryii.*
FIG. 70. Lower leaf epidermis from *L. Henryii.*
FIG. 71. Leaf trichome from the upper surface of the leaf of *L. Henryii.*
FIG. 72. Stem epidermis from *L. Henryii.*

PLATE VIII

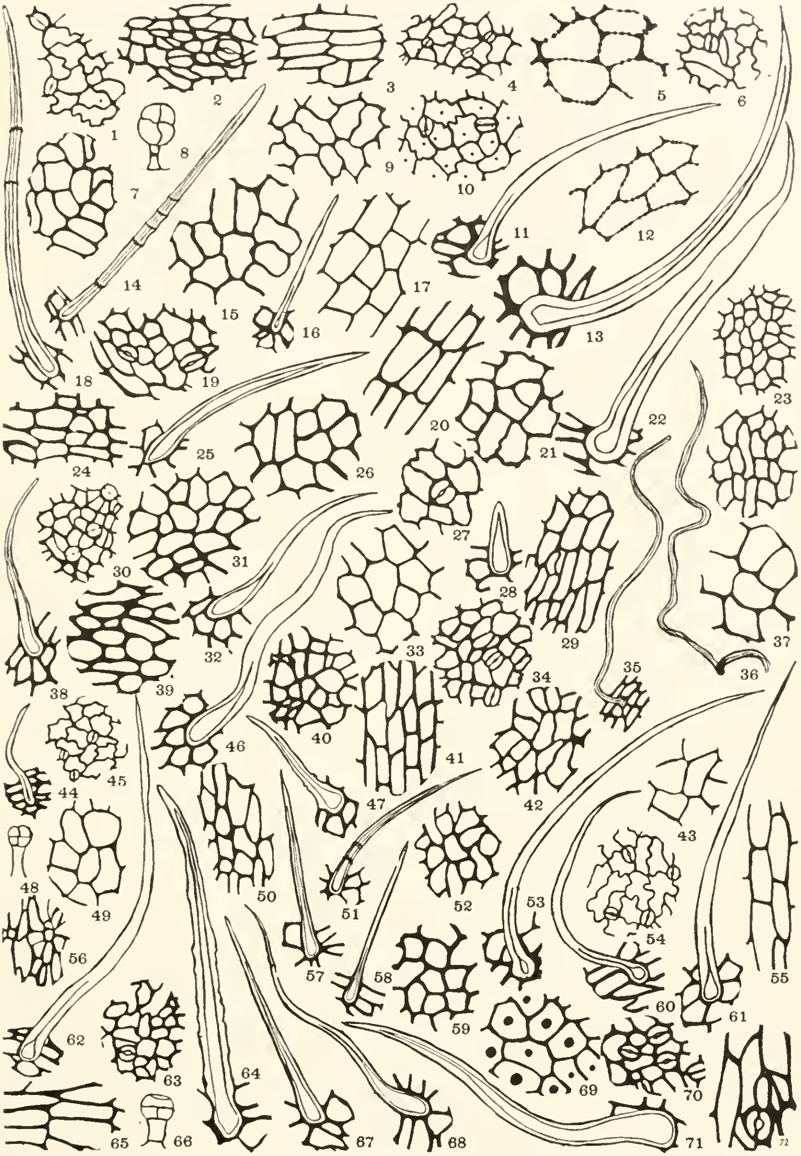
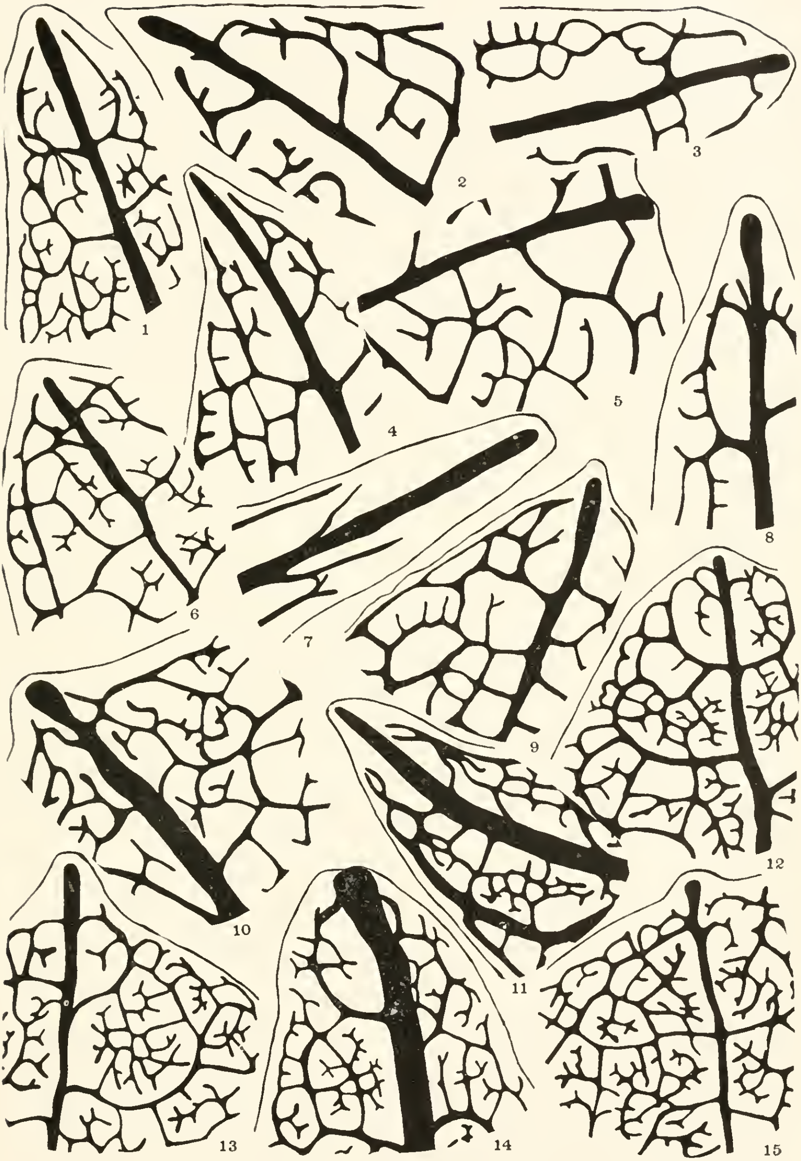


PLATE IX

LEAF BLADES (Venation)

Fig. 1. *L. spinoso Alberti*
Fig. 2. *L. japonica.*
Fig. 3. *L. Webbiana.*
Fig. 4. *L. tatarica.*
Fig. 5. *L. sempervirens.*
Fig. 6. *L. tatarica siberica.*
Fig. 7. *L. deflexicalyx xerocalyx.*
Fig. 8. *L. Henryii.*
Fig. 9. *L. Thibetica.*
Fig. 10. *L. demissa.*
Fig. 11. *L. fragrantissima.*
Fig. 12. *L. coerulea graciliflora.*
Fig. 13. *L. bella.*
Fig. 14. *L. involucrata.*
Fig. 15. *L. Morrowii.*

PLATE IX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THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

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A Simple Micromanipulator

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A SIMPLE technique for the isolation of individual bacteria or spores of fungi has been described by Dickinson.[1] The use of this technique calls for a mechanical device for raising and lowering the point of the capillary glass rod. Controlled vertical movement is all that is essential, since lateral movement of the slide, cover glass and material may be accomplished by means of a mechanical stage.

The expensive manipulator described by Chambers[2] may be used, but it is complicated by provisions for movements other than the one desired. Hanna[3] describes a device for raising and lowering the needle, constructed from parts of a camera lucida and of a hand microtome. Dickinson[4] states that no special micromanipulator is needed and describes the utilization of the microscope condenser for producing vertical movement. It seems, however, that some workers may prefer a simple micromanipulator that may be attached to the stage of the microscope and removed when not in use.

The manipulator here described borrows the feature of the Chambers apparatus which allows simple vertical movement. It has been used by the senior writer in obtaining monospore cultures of various Taphrinaceae.

A plan and side view of the apparatus are shown in Plate X. The body (J) of the manipulator is of aluminum. In use this is clamped to the stage of the microscope by two set screws (K, K). The clamp

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[1] Dickinson, S. A simple method of isolating and handling individual fungal spores and bacteria. Ann. Bot. 40:273-274. 1926.

[2] Chambers, R. New micromanipulator and methods for the isolation of a single bacterium and the manipulation of living cells. Jour. Infect. Dis. 31:334-343. 1922.

[3] Hanna, W. F. A simple apparatus for isolating single spores. Phytopath. 18:1017-1021. 1928.

[4] Dickinson, S. The technique of isolation in microbiology. Phytopath. 23:357-367. 1933.

(I) which holds the needle is mounted on the upper end of a movable rod (H). This rod is enclosed in a sleeve (G) which is held firmly in place by a setscrew (F). The lower portion of this sleeve is threaded and a nut (E), into which the rod (H) is seated, moves up and down on the thread, carrying rod and clamp with it. To insure accuracy of vertical motion a guide (C) is attached to the lower end of the movable rod (H) by means of a screw (B). The notched end of this guide fits closely to a post (A), which is inserted into the body (J) of the apparatus. A setscrew (D) in the guide (C) tightens against the lower end of the movable rod (H) and will, when loosened, allow rotation of the clamp (I).

In using the apparatus the tip of the capillary needle (which has of course been bent at right angles to the tube) is brought to the center of the microscopic field by shoving the needle back and forth in the clamp (I) and by swinging the clamp itself. The setscrew (D) is loosened to allow this swinging of the clamp. When the needle tip has been centered the clamp and setscrew are tightened and subsequent procedure is according to the method described by Dickinson[1].

In making isolations it has been found convenient to use the cell described by Hanna[3]. This is cut from a block of paraffin, with a window for the needle. A large oblong cell has sometimes been employed when it was desirable to mount a larger cover glass. A microscope with complete equipment ready for use is shown in Plate XI.

The body of the apparatus, as has been stated, is of aluminum, the movable rod (H) and the post (A) are of steel, and the other parts are of brass. The manipulator was made in the Fowler Shops, University of Kansas, at a cost of $28, including the charge for making the pattern. A second instrument from the same pattern cost $20. In this second manipulator the post (A) was made of brass, and a spring was added to work against the nut (E) in order to prevent lost motion due to wear of the threads.

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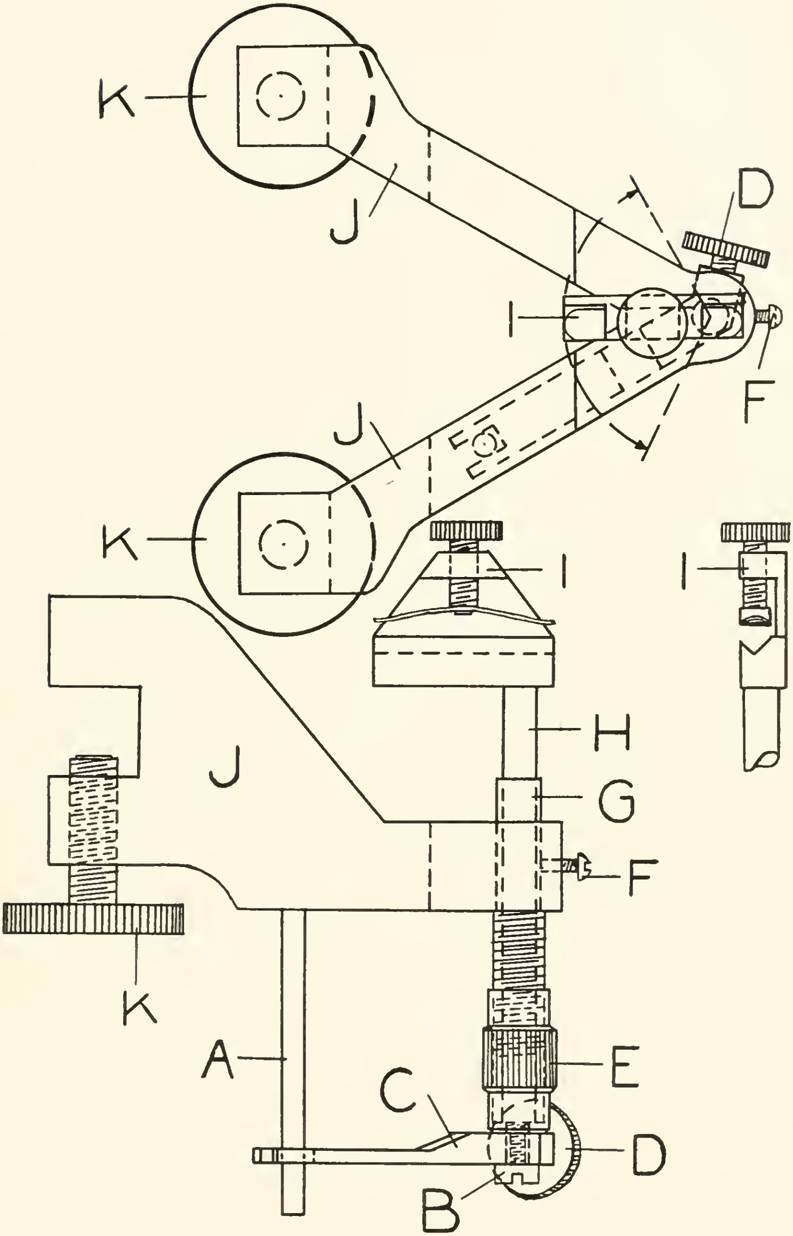
1. Dickinson, S. A simple method of isolating and handling individual fungal spores and bacteria. Ann. Bot. 40:273-274. 1926.

3. Hanna, W. F. A simple apparatus for isolating single spores. Phytopath. 18:1017-1021. 1928.

PLATE X


K
J
D
I
F
J
K
I
I
H
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G
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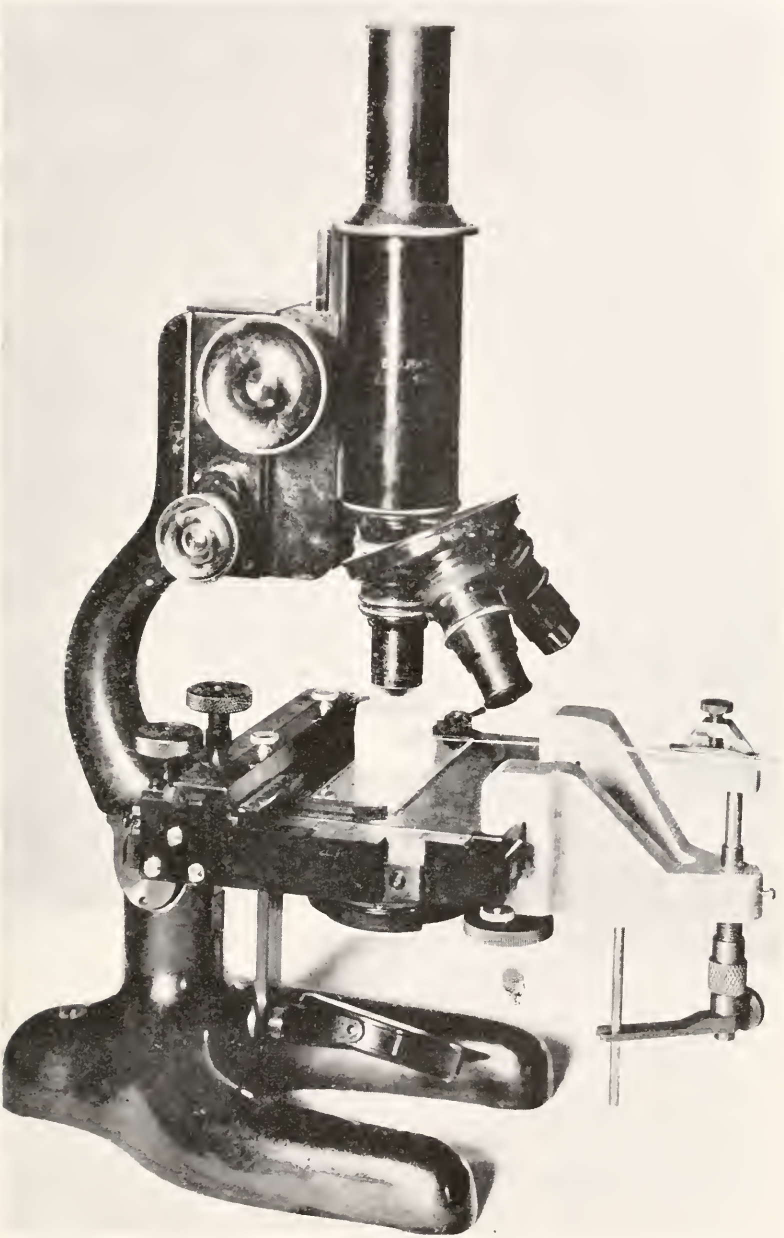
K
A
E
C
D
B

Plan and side view of manipulator, actual size. Explanation of the lettering given in the text.

PLATE XI



Microscope, manipulator, and equipment for isolation assembled for use.

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Vol. XXII.] April 15, 1935 [No. 4.

The Prenatal Growth of the Cat. VI: Changes in the Relative Proportions

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Abstract: This paper gives some of the changes in the ponderal and linear proportions of 229 fetal and 35 newborn cats.

The head decreases in relative weight during the fetal period while the trunk increases. The head is almost as heavy as the trunk at first, but in the largest specimens it is about one fourth as heavy.

The fore limb forms the following percentages of the body weight: 4.4, 8.4, and 6.6 percent. The similar percentages of the hind limb are: 3.5, 10.8, and 8.8 percent. The maximum percentage of the fore limb occurs at 70 grams of body weight and at 100 grams of body weight for the hind limb. The ponderal index of the two extremities rises to its maximum of 170 percent at 1 gram of body weight and then decreases to 71 percent in the largest specimens.

The head and the trunk decrease in relative length, and the tail increases. The head becomes progressively broader up to 40 grams of body weight and then more slender up to birth. The trunk is most slender in the smallest specimens and it becomes stouter during the fetal growth period.

It is shown that the forefoot decreases, the forearm increases and that the relative length of the arm changes but little during the fetal period. The hindfoot decreases likewise, but the other two segments of the hind limb do not change as much in their relative lengths.

The ratios between the segments of the same appendage show that the distal and the proximal segments do not grow as fast as the middle segment. Indices of the homologous segments of the appendages show that the arm is longer than the thigh and the forefoot is shorter than the hindfoot. Both of these indices decrease rapidly at first and then more slowly. The intermembral index likewise decreases from 132 to 99 percent.

MANY animals while developing from birth to maturity increase not only in size but undergo many well-recognized changes in their relative proportions. The large head becomes relatively smaller, and, in the child, the upper extremities likewise decrease, and the lower extremities increase in relative length. The changes so commonly recognized in postnatal life are likewise found in the prenatal period. Scammon and Calkins ('29) have described the prenatal growth of the human fetus and have given a very complete bibliography of the literature. These changes have not been studied in many forms other than in man and in the primates (Schultz, '26).

The growth in weight and in length of the cat fetus and of its chief divisions has been given in the first three papers of this series. This paper will attempt to show some of the changes in the proportions of the cat during the fetal growth period. The description of the 229 fetuses and 35 newborn kittens and the methods of weighing and measuring have been given in the first paper of this series and need not be repeated here.

CHANGES IN RELATIVE WEIGHT

The relative proportions by weight of the head, trunk, fore limbs and hind limbs are shown graphically in Plate XII, figure 1. These relative values were determined from the absolute weights computed by means of the empirical formulae given in the first paper of this series. This shows the relative size of the head in the cat fetus decreasing from its maximum of 36 percent of the total body weight in the smallest specimens to 16 percent in the largest specimens.

The trunk increases rather rapidly at first from 41 percent to its maximum of 68 percent in the largest specimens. The trunk, as it is called in this paper, includes the neck, the trunk proper, and the tail. In the dissection of each specimen, the head was removed by an incision separating the atlas and the occipital condyles. The two pairs of extremities were removed, but the tail was left attached to the trunk. To show better the ponderal relations of the head and the trunk, the head-trunk index, or $\frac{\text{head weight} \times 100}{\text{trunk weight}}$, was determined from the calculated values. This index was found to be 98 at 0.3 grams of body weight. It drops rapidly to 73 at one gram of body weight, to 44 at 10 grams, and to 39 at 20 grams of body weight. It continues to decrease, though at a slower rate, to 24 at 190 grams of body weight. This index and figure 1 (Pl. XII) both show the relatively large size of the head at first, almost equalling the trunk in weight, and the slower but ultimately greater growth of the trunk. The head increases 300 times and the trunk 1,230 times in weight during this period.

Plate XII, figure 1, shows the fore limbs forming 4.4 percent of the body weight at first and increasing to a maximum of 8.4 percent at 70 grams of body weight, and then decreasing slowly to 6.6 percent in the largest specimens. The growth of the hind limbs follows a course similar to that of the fore limbs. They start at 3.5 percent of the body weight, reach their maximum of 10.8 percent at 100 grams of body weight, and then decrease to 8.8 percent in the largest specimens.

The ponderal index of the two extremities or, $\frac{\text{weight fore limbs} \times 100}{\text{weight hind limbs}}$, was determined for each ten grams increase in body weight and some of these values are given in table 1. The increase in this index from 0.3 to 1.0 grams of body weight may be due to inaccuracy in removing from the body and in weighing, for these appendages are very small, but it probably means that the initial rapid growth of the fore limbs is terminated at about 1 gram of body weight. From this point on to 100 grams of body weight, the rate of growth of the hind limbs exceeds that of the fore limbs. From 100 grams on, the index increases slowly, indicating that the fore limbs again grow slightly faster than the hind limbs. The fluctuation in this index suggests the rythmic growth found by Landauer ('34) and Schmalhausen ('26 and '27) and others in the chick embryo. Scammon ('30) gives values for this index in the human fetus for only 6, 8, and 10 months of age. For these ages the index decreases progressively. The total growth of the hind limbs is greater than that of the fore limbs during this period, resembling the changes described by Scammon and Calkins ('29) for the human fetus. The fore limbs of the cat fetus increase 1,250 times and the hind limb 2,100 times in weight during this period.

In general, the relative ponderal changes in the cat fetus resemble those in the human fetus. The head is very precocious. It is nearly the same size as the trunk at first, but decreases in relative weight. The fore limb is heavier than the hind limb in the smallest fetuses and it reaches its maximum relative weight earlier. After a body weight of 20 grams is attained, the hind limb forms a larger percentage of the body weight. All of these illustrate Scammon's ('33) "law of developmental direction."

CHANGES IN THE LINEAR PROPORTIONS

The relative lengths of head, trunk, and tail are shown in Plate XII, figure 2. The lengths of the trunk were not determined directly, but the difference between the nose-anus length and the head length gives a fairly accurate idea of the length of the trunk plus the length of the neck. The weight of the neck has been included with the trunk weight in the preceding section. These linear changes are not as pronounced as are the ponderal changes shown in Plate XII, figure 1. The head decreases from its maximum relative length of 20 percent at 0.3 gram of body weight to a minimum of 16.73 percent at 130 grams of body weight, and thereafter it increases slightly to 17.87 percent at 190 grams of body weight. This last slight increase in relative length occurs in the newborn kittens, for all of the specimens above 121 grams of body weight are newborn kittens. The trunk likewise decreases in relative length from its maximun of 68.6 percent at 0.3 gram of body weight to 54.5 percent. The tail is the only one of these parts which increases throughout. It increases from 11.4 to 27.6 percent.

The head decreases in relative weight and in relative length, as shown in the two preceding figures, and to get some idea of this change, the weight per unit of length was determined for each ten grams increase in body weight. These have no significance as absolute values, for the head is not a symmetrical cylinder, but it serves merely as a means of comparing the changes in length and in weight. In the smallest specimens there are fifteen milligrams per millimeter of length. This increases, rapidly at first and then more slowly, but continuously, to a maximum of over 700 milligrams per millimeter of length.

It has been shown above that the trunk decreases slightly in relative length, but increases in relative weight during this period. Its weight per unit of length was found in a similar manner to that for the head and, like the values for the head, these weights increase rapidly at first and then more slowly. The changes are: from 4 milligrams per millimeter of length in the smallest specimens to 962 milligrams per millimeter in the largest. This would indicate that the trunk of the cat becomes stouter during the fetal period. Schultz ('23) states that the trunk in man becomes more slender during fetal development. He finds that the ratio of the trunk circumference to trunk height decreases in the fetal period. Using the calculated values, the ratio of the circumference of the thorax to the trunk length, or $\frac{\text{circum. thorax} \times 100}{\text{trunk length}}$, was found for the various body weights. This index begins at 58.3 percent in the smallest specimens and increases continuously to 92.6 per cent at 190 grams of body weight. In order to get another means of studying the changes in the shape of the trunk in fetal life, the ratio of the transverse diameter of the thorax to the trunk length was found for the same body weights. This index, $\frac{\text{trans. dia. thorax} \times 100}{\text{trunk length}}$, likewise increases from 20.0 percent at 0.3 gram of body weight to 26.1 percent at 190 grams of body weight. Hence, we must conclude that in the cat the trunk becomes stouter during fetal growth.

The ratio of the transverse diameter of the head to the transverse diameter of the thorax was studied. Using the computed values of the two diameters, the index, $\frac{\text{trans. dia. head} \times 100}{\text{trans. dia. thorax}}$, begins at 95.8 percent at 0.3 gram of body weight and rises to its maximum of 105.4 percent at 10 grams of body weight. Thereafter it decreases slowly and regularly to 83.9 percent at 190 grams of body weight. The initial rise here may be explained as was the rise in the ponderal index of the two extremities, as due to the termination of the initial period of rapid growth of the head. The change in the shape of the head as shown by the cephalic index (discussed in the following paragraph) may affect this index slightly. The decline is probably due to the increased rate of growth in the transverse diameter of the trunk, thus lowering the index.

The cephalic and the thoracic indices and the ratio of the neck circumference to the thoracic circumference have been given in a previous paper (Latimer, '31). The slight changes in the cephalic index show that the head tends to become a little broader up to about 40 grams of body weight and then more slender, with an index at the end about equal to that of the smallest specimens. Schultz ('26) suggests that the early growth of the brain tends to mold the cranial part of the skull into a spherical shape. The later development of the facial part of the skull and the change toward the newborn shape of the head may be the explanation of the slight elongation in the fetal cat head, beginning at 40 grams of body weight. When these cephalic indices were plotted (not shown), the cases were more closely distributed than many of the other dimensions, suggesting that there was a marked uniformity in the shape of the fetal cat head. In a study of several dimensions of the muskrat skull (Latimer and Riley, '34) the correlation between skull length and skull breadth was next to the lowest correlation found for the skull dimensions. This would suggest either that there is a difference in this index in different species of animals, or that the individual variation in head shape makes its appearance in postnatal life. This must be answered by data from the same species. Data are being collected now on these dimensions of the head of adult cats, but there are not enough to warrant any conclusions as yet. The thoracic index (fig. 6 of No. 2) has an initial rise, which has been discussed in a previous paper, and then averages 114 percent, showing that there is no change in this index in the late fetal or newborn stage. The neck becomes relatively a little more slender than the thorax, as shown in figure 9 of this earlier paper.

These data show that the head of the cat during the fetal growth period decreases in relative weight, relative length, and for all but the very early part of this period, its transverse diameter grows less rapidly than the similar diameter of the trunk. Meanwhile the trunk increases in relative weight but decreases somewhat in relative length. Unlike the human fetus, it becomes less slender during fetal development. The weight of the fore limbs exceeds that of the hind limbs at first, but above one gram of body weight the hindlimbs gradually overtake and surpass the fore limbs in weight. There is another very slight spurt in the growth of the fore limbs toward the end, but not enough to markedly change the ratio of the two extremities established at 100 grams of body weight.

CHANGES IN THE LINEAR PROPORTIONS OF THE EXTREMITIES

In the third paper of this series, the lengths of the fore limbs and of the hind limbs have been shown with reference to the nose-anus length. The fore limb increases from 20 to 40 percent and the hind limb increases from 10 to a little over 40 percent of the body length. The ratios of the lengths of the extremities to the trunk length is frequently used, and these ratios derived from the computed lengths of the fore limb, hind limb, and trunk (as described above) are given in table 2. These ratios were computed for every ten grams increase in body weight, but to save space, they are given for each 20 grams increase above 30 grams of body weight. Schultz ('26) gives these ratios for the human fetus, and they are larger than for the cat fetus. Unfortunately, the body length or trunk length measurement is not the same as the measurement he used, and so we cannot compare the relative lengths of the extremities in the cat and in man. He finds the upper extremities relatively longer than the lower throughout the entire period with the exception of the 34th week. In the cat fetus the fore limb exceeds the hind limb in length until a body weight of 110 grams is attained, and thereafter the hind limbs are longer. The growth of the two extremities of the cat fetus resembles that of the human fetus in that both extremities grow more rapidly than the body length or the trunk length. Also the most rapid change occurs in the early part of the fetal period in both the cat and the human fetus, as described by Schultz ('26), and Scammon and Calkins ('29).

The lengths of the three segments of the fore limb were measured and these lengths relative to the length of the entire extremity were determined, and from these percentages figure 3 in Plate XIII was constructed. The forefoot decreases from about 37 percent of the length of the fore limb in the smallest specimens to about 28 percent in the largest. The forearm increases in relative length, or from 27 to 36 percent. The relative length of the arm changes less than either of the other two segments. It forms about 36 percent of the extremity at first, increases to about 38 percent, and then decreases to about its initial relative length.

Figure 4 (Pl. XIII) shows similar changes in the relative lengths of the segments of the hind limb. The hindfoot decreases from 47 to 43 percent, or less than the change in the relative length of the forefoot. The leg forms about 22 percent at first. It increases rapidly at first and then decreases slowly to about 24 percent in the largest specimens. The thigh increases at first in relative length, or from 32 to 35 percent, and then decreases until in the largest specimens it forms about one third of the length of the entire extremity.

These two figures show that the most marked changes in the linear proportions take place at the beginning of this growth period and that both feet decrease in relative length, with the greatest decrease in the forefeet. Plate XIII, figure 4, shows an apparently greater variability in the relative length of the leg and the thigh following the initial change. This may be due in part, but not entirely, to the greater difficulty in measuring the length of the leg as described in the preceding paper (Latimer, '33).

The ratios of the adjacent parts of the same extremity were determined for each specimen and the individual indices, together with a curve drawn by inspection, are shown in Plate XIV, figure 5. The averages for each ten grams increase in body weight for each of these indices, as well as the indices in Plate XIV, figure 6, are given in table 1 of the third number of this series. It seemed best to give the curves and individual cases to show better the changes in, and the distribution of, these indices. It will be noticed that the first and the third curves from the top both decrease rapidly at first and then more slowly. The first shows the ratio of the hindfoot to the leg $\left(\frac{\text{foot length} \times 100}{\text{leg length}}\right)$ and the third curve, the ratio of the forefoot to the forearm $\left(\frac{\text{foot length} \times 100}{\text{forearm length}}\right)$. This again shows the relative decrease in the feet, especially the forefeet, which has been shown in figures 3 and 4 on Plate XIII. The individual cases for the upper curve are not given, as they were very widely scattered. It has already been shown (Latimer, '33) that the leg is a variable part of the hind limb. There is not as much change in the relationship of the leg and the thigh $\left(\frac{\text{leg length} \times 100}{\text{thigh length}}\right)$ (bottom curve) but the arm forms an increasingly larger ratio to the forearm as shown in the second curve from the top $\left(\frac{\text{forearm length} \times 100}{\text{arm length}}\right)$. Scammon and Calkins ('29) find the middle segment of both extremities growing more rapidly than the proximal and that is, in general, the findings for the cat fetus. They find that the distal segments grow more rapidly than the middle, but this is not true for the cat fetuses, for both curves (upper and second from the bottom) show marked decreases at first with an increase for the foot-leg index during the middle of the growth period.

The curves in Plate XIV, figure 6, were prepared in a similar manner to those in Plate XIV, figure 5, and these show the changes in the ratios of the homologous parts of the two extremities. The upper curve gives the humero-femoral index $\left(\frac{\text{length arm} \times 100}{\text{length thigh}}\right)$ and it shows that the arm is longer than the thigh throughout the entire period. The lowest curve gives the ratio of the forefoot to the hindfoot $\left(\frac{\text{length forefoot} \times 100}{\text{length hindfoot}}\right)$ and it shows that the forefoot is shorter than the hindfoot in all of the specimens except a very few of the smallest. The general trend of the middle curve, or the intermembral index $\left(\frac{\text{length fore limb} \times 100}{\text{length hind limb}}\right)$ is similar to that of the human fetus. This index shows that the fore limb decreases from 132 percent of the hind limb to 99 percent in the largest specimens, or as has already been shown, the hind limb grows more in the fetal period than does the fore limb.

SUMMARY

The head decreases in relative weight during the fetal period while the trunk increases. The head is almost as heavy as the trunk at first, but in the largest specimens it is about one fourth as heavy.

The fore limb forms the following percentages of the body weight: 4.4, 8.4, and 6.6 percent. The similar percentages of the hind limb are: 3.5, 10.8, and 8.8 percent. The maximum percentage of the fore limb occurs at 70 grams of body weight and at 100 grams of body weight for the hind limb. The ponderal index of the two extremities rises to its maximum of 170 percent at 1 gram of body weight and then decreases to 74 percent in the largest specimens.

The head and the trunk decrease in relative length, and the tail increases. The head becomes progressively broader up to 40 grams of body weight and then more slender up to birth. The trunk is most slender in the smallest specimens and it becomes stouter during the fetal growth period.

It is shown that the forefoot decreases, the forearm increases, and that the relative length of the arm changes but little during the fetal period. The hindfoot decreases likewise, but the other two segments of the hind limb do not change as much in their relative lengths.

The ratios between the segments of the same appendage show that the distal and the proximal segments do not grow as fast as the middle segment. Indices of the homologous segments of the appendages show that the arm is longer than the thigh and the forefoot is shorter than the hindfoot. Both of these indices decrease rapidly at first and then more slowly. The intermembral index likewise decreases from 132 to 99 percent.

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TABLE 1.—Ponderal index of the extremities or $\frac{\text{Wgt. Fore limb} \times 100}{\text{Wgt. Hind limb}}$. The weights of the extremities were taken from Table 3 of the first paper of this series.

Body weight, grams	Index	Body weight, grams	Index	Body weight, grams	Index
0.3	134.8	60	82.0	130	74.0
1	170.2	70	80.1	140	74.1
10	109.7	80	78.4	150	74.1
20	97.7	90	77.1	160	74.2
30	91.4	100	73.3	170	74.3
40	87.3	110	73.8	180	74.4
50	84.3	120	73.9	190	74.4

TABLE 2.—Ratios of the computed lengths of the extremities to the trunk length. The linear dimensions were computed for each 10 gram increase in body weight, but above 30 grams of body weight they are given for each 20 grams increase in body weight.

Body weight, grams	Fore limb × 100 / trunk.	Hind limb × 100 / trunk.	Body weight, grams.	Fore limb × 100 / trunk.	Hind limb × 100 / trunk.
1	33.8	21.0	90	51.3	51.0
10	49.3	43.3	110	52.0	52.1
20	50.6	46.8	130	52.9	53.2
30	50.8	48.2	150	55.9	56.6
50	50.8	49.4	170	58.8	59.8
70	50.8	50.1	190	61.5	62.7

PLATE XII

FIG. 1. The relative weights of the head, trunk, fore limbs, and hind limbs. The ordinates give the percentages and the abscissae, the body weights in grams.

FIG. 2. The relative lengths of the head, trunk, and tail. The percentages are given as ordinates and the abscissae give the body weights in grams.

PLATE XII

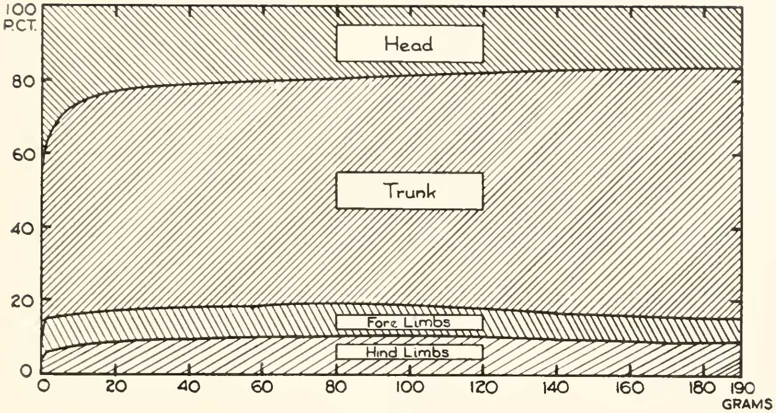

FIGURE 1

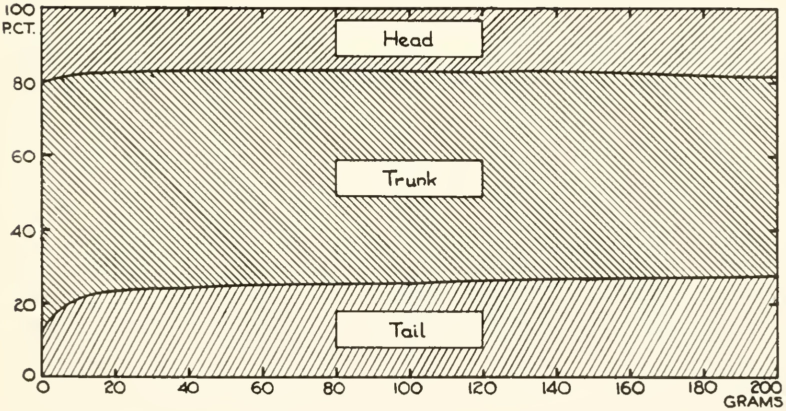

FIGURE 2

PLATE XIII

FIG. 3. The relative lengths of the three divisions of the fore limb. The ordinates give the percentages and the abscissae the body weights in grams.

FIG. 4. The relative lengths of the three divisions of the hind limb. The ordinates give the percentages and the abscissae the body weights in grams.

PLATE XIII

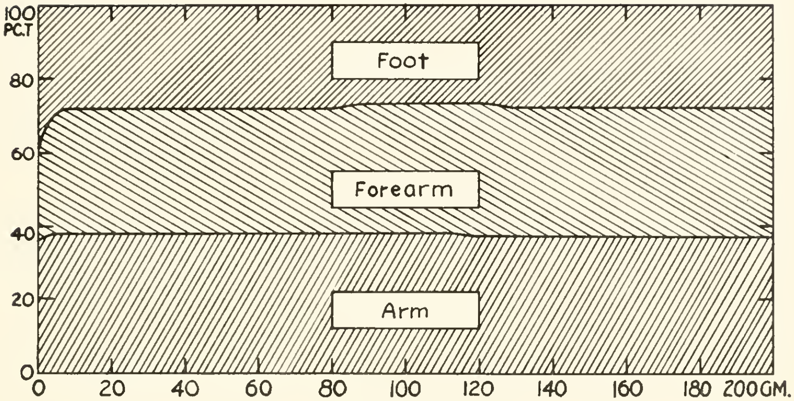

FIGURE 3

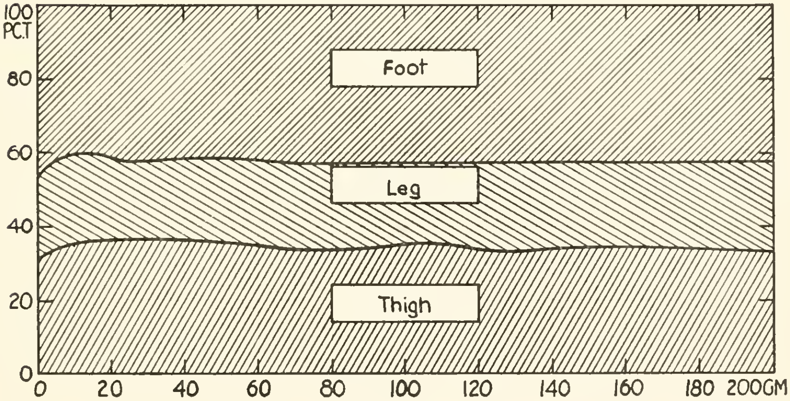

FIGURE 4

PLATE XIV

FIG. 5. Four indices of adjacent parts of the extremities plotted on body weight. The upper curve $\left(\frac{\text{Hf.}}{\text{L.}}\right)$ with no cases shown, represents the foot-leg index, and its values are given in the right margin. The second curve $\left(\frac{\text{Fa.}}{\text{A.}}\right)$ represents the brachial index, and its percentages are given in the left margin. All of the individual cases are shown as circles. The curve which is third from the top throughout most of its course $\left(\frac{\text{Ff.}}{\text{Fa.}}\right)$ represents the forefoot-forearm index. Its percentages are given in the left margin and all of the individual cases are shown as dots. The lowest curve with all of the cases shown as circles $\left(\frac{\text{L.}}{\text{T.}}\right)$ represents the leg-thigh index. Its percentages are shown in the left margin.

FIG. 6. Three indices of homologous parts of the extremities. The upper curve with the cases shown as circles $\left(\frac{\text{A.}}{\text{T.}}\right)$ represents the arm-thigh index. The percentages of all of these curves are given in the left margin and all are plotted on body weight in grams. The middle curve, with the cases shown as dots, $\left(\frac{\text{F. L.}}{\text{H. L.}}\right)$ represents the intermembral index and the lowest curve $\left(\frac{\text{Ff.}}{\text{Hf.}}\right)$ represents the forefoot-hindfoot index, with the individual cases shown as circles.

PLATE XIV

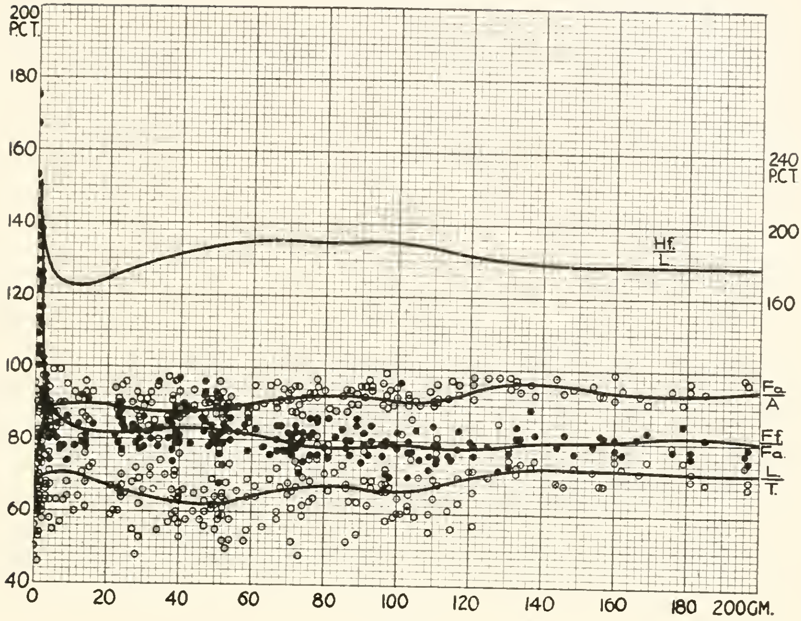

FIGURE 5

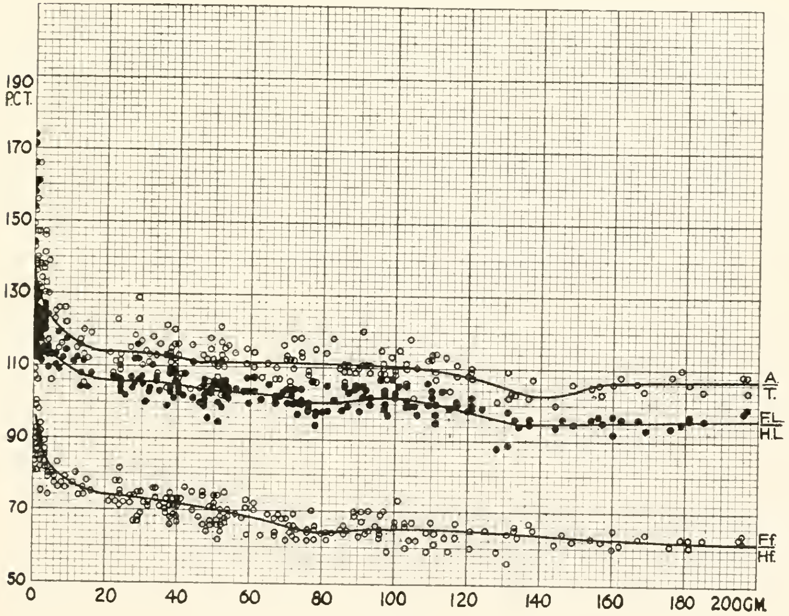

FIGURE 6

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A Vertebrate Fauna from the Type Locality of the Ogallala Formation

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(Contribution from the Museum of Paleontology, University of California)

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ABSTRACT: The vertebrate fauna from the type locality of the Ogallala formation at Ogallala, Nebraska, is described and its relation to other known Tertiary faunas is discussed.

The faunas collected in various outcrops of the Ogallala are generally considered to represent typical Pliocene assemblages, the most primitive among them being the Republican River "phase A" (lower) of the author and the most advanced the Blanco fauna of Texas.

The described type locality fauna belongs together with the rest of the Ogallala faunas between these two extreme phases.

IN 1930 while working on the stratigraphy and distribution of the Ogallala formation, Maxim K. Elias, of the State Geological Survey of Kansas, collected the first vertebrate fossils from the type locality of these beds. The following year Elias and H. H. Lane, curator of the University of Kansas Museum of Natural History, sent a field party into this area to secure additional material. This party was in charge of C. W. Hibbard, who was assisted by W. C. McNown and Max M. Elias. The collections resulting from these activities were turned over to the writer for study and description, through the courtesy of Dr. H. H. Lane.

This collection came from the Feldt Ranch (SE ¼ of sec. 33, T. 14 N., R. 38 W), two miles east and one half mile north of the town of Ogallala, Keith county, Nebraska. The exposures here are between the North and South Platte rivers, which join at the town of North Platte, a few miles to the east of Ogallala. In the vicinity of Ogallala the river beds have a general elevation of 3,200 feet, while the plateau between the two streams stands at about 3,400 feet. This high land rises abruptly from the valley floor and forms a long line of east-west bluffs, which consist chiefly of the Ogallala formation. According to Robert W. Hay (1895, p. 580) the section at this point is about 240 feet thick, and is composed of calcareous grits and sand.

The fossil bed itself is at the head of a small north-south draw about thirty-five feet below the top of the section at this place. The material was distributed through a three-foot layer of fine sand, but does not show any water-worn surfaces or other evidences of transportation. Just above this sandy horizon is a layer of the characteristic calcareous grit, from which most of the Prosthennops material was taken. Lack of time prevented extensive working of this locality, but a sufficiently large collection was obtained to place a definite age on these *type* beds, as well as to show something of their relationship to allied faunas.

DISTRIBUTION OF THE OGALLALA FORMATION

Since the original definition of the Ogallala formation in 1899 by N. H. Darton, the areal limits of this unit have been steadily extended. Publications of the United States Geological Survey and the various state geological surveys of this region have shown that the Ogallala is one of the most extensive North American continental deposits. In general its distribution is coincident with the high plains of the Mid-Continent, where it has been recognized in the following states:

1. NEBRASKA

The Ogallala occupies the entire southwestern corner of the state, continuous from the type locality at the town of Ogallala, Keith county, Nebraska. It was recognized and mapped in this area by Darton (1899, 1905, pp. 178, 179), G. E. Condra (1907, pp. 19, 20), and the Nebraska Geological Survey (E. H. Barbour, 1903, pp. 163-165).

2. WYOMING

Here the Ogallala occurs in the extreme southeastern corner of the state, and is probably confined to Laramie county. It has not been clearly mapped and is not, at present, fully distinguished from the Arickaree which it overlies (Darton, 1905, p. 178), (Lee, W. T., 1916, p. 37).

3. KANSAS

Beneath the soil mantle the Ogallala makes up most of the surface of the state west of the 99th meridian. It is probably better developed in this area than in any other. The Belleville formation of Wing (1929, pp. 19-21) is, on the basis of unpublished stratigraphic evidence, now considered as Pleistocene in age, and not as a part of the Ogallala as the original author suggested.

In the Kansas Geological Survey reports, "The Geology of Wallace county, Kansas," by Maxim K. Elias, deserves special mention. It has long been thought impossible to work out any detailed stratigraphy within the Ogallala section, but Elias has shown that this may be accomplished. His work is the first in which this unit is attacked in detail, and the results he obtains with the fossil grass seed zones as well as detailed stratigraphy make his paper second only to those of the pioneer N. H. Darton.

4. COLORADO

The Ogallala covers the eastern tier of counties, with the exception of the Arkansas River Valley. It extends, as a broad triangle, as far west as 104° longitude. The Nussbaum formation of Gilbert (1897, p. 4) and others was included in the Ogallala by Darton (1905, p. 179, 1906, p. 34), who mapped most of eastern Colorado.

5. OKLAHOMA

In Oklahoma the Ogallala extends over most of Cimarron, Texas and Beaver counties, as well as eastward into Ellis county. In this area it was recognized and mapped by the United States Geological Survey (C. N. Gould, 1905, pp. 79-81) under the direction of Darton, and later by the Oklahoma Geological Survey (Rothrock, 1925, pp. 68, 69; Gould, 1926, pp. 26-31, 1926A, pp. 24-33).

6. TEXAS

The Ogallala formation is extensively developed in the Panhandle of Texas. The area north of the 32d parallel and west of the 100th meridian is almost entirely covered by this mantle. It was recognized in this area by Gould (1906, pp. 25-30, 1926, pp. 24-33), later by Darton (1928, p. 58) and was mapped by the University of Texas Bureau of Economic Geology (1916). The Tertiary geology of this state has been the subject of many papers by various authors, but, unfortunately, all work thus far has been localized. There have been many formations named here, such as the Paloduro Beds, Goodnight Formation, the Blanco of Cummins, the Clarendon Beds of Gidley, and the Hemphill Beds of Reed and Longnecker. The faunas of some of these formations may differ slightly, as well as the lithology of the local section, but it has not been possible for subsequent investigators to show that these beds exist as separate, mapable, stratigraphic units (Gould, 1906, p. 27, 1926, pp. 24-33; Matthew, in the Reed and Longnecker Report, 1932, p. 69). In my opinion it would clarify the problem if the above "formations" were to be referred to as zones of the Ogallala [*e. g.*, Ogallala formation (Clarendon zone)].

7. NEW MEXICO

The Ogallala formation covers a large part of the eastern tier of counties in New Mexico, with outliers as far west as the 105th meridian. Over this area it has been recognized and mapped by Darton (1928, p. 58).

Over most of the above-described region the Ogallala overlies, unconformably, rocks of Mesozoic and Paleozoic age. It occurs as a mantle, masking the underlying formations and grading up into local Pleistocene deposits or the recent soil. Darton and others have set forth its stratigraphic position and its relationship to other formations of like character and age. In certain sections it is difficult, if not impossible, to distinguish it from Pleistocene or later deposits which overlie it. It is quite distinct from the older series except in Laramie county, Wyoming, where it has not been clearly separated from the underlying Arickaree.

I do not intend to imply that the areal distribution of the Ogallala, as set forth by various writers, is more than tentative. Future work in this region will cause marked changes in its delineation, especially in central and northern Nebraska. But it is at present impossible to do more than follow the above-cited accounts of the extent of these beds, however scattered they may be.

SUMMARY OF THE FELDT RANCH FAUNA

LACERTILIA

A fragment of the pelvic bone of a reptile establishes the presence of a small lizard in these beds. The specimen is too incomplete to identify further than the order.

AVES

A single fragment of the sternum of a bird was found at this locality. Mr. L. V. Compton, of the Museum of Vertebrate Zoölogy, University of California, makes the following statement regarding this fragment: "The specimen consists of all the right and half the left caracoidal sulci, and a small section of the sternal plate on the right side. This sternum represents a form related to the anserines, altho it presents characters that are different from those found in any of the present-day genera of North American ducks and geese, and it is probable that it is a member of an unknown genus and is a new species. Since the specimen is incomplete and is of a somewhat nondiagnostic element, it is not considered sufficient evidence upon which to base a new form. It is approximately the same size as the sternum of the Canada goose (*Branta c. canadensis*), but it is distinctly lighter in structure."

RODENTIA

Hypolagus

Two teeth, the proximal end of an ulna, and the astragulus of a rabbit are referred to the genus Hypolagus. Although this material is fragmentary and insufficient for specific identification, it resembles closely the type of *Hypolagus vetus* (*Lepus vetus*). This species is known from the Thousand Creek (Pliocene) and Virgin Valley (Miocene) Beds of Nevada and was provisionally recorded from both the lower Snake Creek and Sheep Creek Beds by Matthew (1924, pp. 86, 87).

Mylagaulus sp.?

This genus is represented by a right femur which, in all its details and size, is exactly like those figured by Matthew (1902, p. 295) from associated skeletons. Its occurrence in this stage is to be expected, since that family is sparsely represented in the late Tertiary Beds.

Dipoides sp.?

(Plate XV, fig. 1)

A single upper molar, a part of the incisor and the astragulus of a beaver are all that may be identified as belonging to this genus The molar tooth (Pl. XV, fig. 1) possesses an "S" pattern, formed by a lateral groove from crown to base on either side. The tooth is open at the base and is similar to those occurring in the Thousand Creek Beds of Nevada and the Rattlesnake Beds of Oregon. The incisor has a convex anterior face, and is much like that of Eucastor except for its slightly larger size. The astragulus is approximately one fourth larger than the astragulus of Eucastor from the Esmeralda Formation (Fish Lake Valley Beds) of Nevada.

INDET.

In addition to the genera listed above there are several fragments which I regard as indeterminate. They are mostly fragments of incisor teeth and limb elements. One lower incisor is quite flattened, and while it is not Palaeocastor it is comparable to certain species of it. A femur, radius and tibia could not be determined accurately enough to name. Rodents must have been very common here and were probably represented by at least five genera.

CARNIVORA

OSTEOBORUS OR AELURODON

A single fourth metatarsal of a moderately large carnivore I refer to the Osteoborus-Aelurodon group. Although generic reference is questionable on such scanty evidence, the size and shape of the bone places it definitely somewhere in that group. It is not as robust as the same element in Aelurodon cf. *A. hadenyi* from the Esmeralda Formation (Fish Lake Valley Beds) of Nevada. It agrees far more closely in detail with the series of Osteoborus metatarsals from the Hemphill Beds (Coffee Ranch quarry) of Texas. This latter genus is quite common in faunas of this age. Our specimen is slightly more robust than the Texas species *O. cyonoides*.

Felis sp.?

(Plate XV, fig. 2)

A large fourth metatarsal (K. U. Mus. Pal. No. 3759; Pl. XV, fig. 2) from the Feldt Ranch locality belongs to some large carnivore. It is much larger than either Machairodus or Osteoborus, in fact it is considerably larger than any known Pliocene form. In size and construction it is identical with the well-known Pleistocene species *Felis atrox*, which has recently been so well figured and described by Merriam and Stock (1932, p. 158). These authors give a series of maximum and minimum measurements of this element, based upon thirty specimens from Rancho La Brea. The Nebraska specimen agrees quite closely in general size, but has some slight differences in proportion. This, so far as I am aware, is the first bit of evidence of an exceptionally large felid in the Pliocene.

Bassariscus sp.?

In the collection from this locality was the small lower jaw of a Bassariscus. It was retained by C. W. Hibbard, of the University of Kansas, for study and description. I have not had the opportunity to examine the specimen in detail, but Mr. Hibbard informs me that it is probably a new species.

PERISSODACTYLA—RHINOCEROTIDAE

In the plains region rhinoceros remains are the most common of all fossils, with the exception of those of the horse. These fall into several genera and one or two subgenera, which are in turn divided into many species.

Out of this wealth of material two main lines of phylogeny have been pointed out by W. D. Matthew and other writers. These two lines form the Miocene to Pliocene genera Aphelops and Teleoceras. A third genus, Peraceras, is not yet sufficiently known to be clearly separate from the Aphelops line. In the two main genera, Aphelops and Teleoceras, several well-defined characters have been pointed out by Osborn, Matthew, Lane and Stirton. Following these characters the Ogallala material agrees with the genus Teleoceras on the following points.

1. Molars more hypsodont in comparison with those of Aphelops.
2. Reduced premolars, P_2 very small.
3. A short, deep jaw, such as would fit a moderately short skull.
4. A character which has been called to my attention by R. A. Stirton is: The relative depth of the jaw beneath P_2 is much less than beneath M_3 in Teleoceras, while in Aphelops the two are almost the same. This is, possibly, correlated with the reduced premolars and shortened jaw of Teleoceras.

5. The tibia and metatarsal, in this collection, are extremely short.

The above points place the Ogallala rhinoceros in the genus Teleoceras. In this genus there are eight known species, six of which are described from the same general region in which the Feldt Ranch specimens were collected. These six species may be readily divided into two groups, a more primitive Upper Miocene stock composed of *T. medicornutus* Osborn and *T. minor* Olcott from the Pawnee Creek and Arickaree Formations. The second group, more advanced in its characters, is made up of *T. major* Hatcher, *T. fossiger* (Cope), and *T. hicksi* Cook, all of which are from the Lower Pliocene. Within this second group additional material will probably show fewer species, since the individual variation in an animal as large as a rhinoceros is bound to be great. *T. major* has been considered by Matthew (1918, p. 209) as a large male of *T. fossiger* (Cope), and can no longer be recognized as distinct. The genus Paraphelops Lane may belong close to this second Teleocerine group. It is distinctly Teleocerine in the depth of the ramus beneath P_3, in the reduction of the premolar teeth, and in the height of the crowns of the teeth in comparison with Aphelops. The size and position of the tusks, as well as the length of the symphysis, are characters now known to be of little value. With these points in mind the Ogallala specimens may be referred to:

Teleoceras fossiger (Cope)

(Plate XVI)

1878. *Aphelops fossiger* Cope. Descriptions of new extinct Vertebrata from the upper Tertiary and Dakota formations. Bull. U. S. Geol. and Geog. Surv. Territories, 1878, IV, p. 382.

1894. *Teleoceras major* Hatcher. Amer. Geologist XIII, pp. 360-361.

Description of the Material. The lower jaws (K. U. Mus. Pal. No. 3752; Pl. XVI.) are those of a large male. They are well preserved, lacking only the left tusk and the tip of the left coronoid. The ramus is thick, heavy, and is larger in lineal dimensions than most of the recorded specimens of *T. fossiger*. This robustness is the only character upon which *T. major* could be separated from *T. fossiger,* but our specimen tends to bridge over this difference in size and warrants the reference of both to the older species. The canines are heavy, widely flaring, and rather short. They are not noticeably upright or procumbent, and when compared with a series of *Aphelops mutilus* jaws from the Hemphill Beds (Coffee Ranch quarry) of Texas they cannot be separated from them by this character.

The diastema behind the tusk is short; P_2 much reduced (represented by alveoli, only, in this specimen); P_3 small, triangular, less than three fourths the length of P_4, and also sits considerably higher in the ramus than does P_4; pre- and post-fossette shallow; P_4 molariform, pre-fossette shallow; M_1 heavily worn; M_2 crowded against M_1, partly overlapping it on the inner side; M_3 as in all other Teleocerines. The molars are more hypsodont than those of Aphelops, they bear no cingula, and seem crowded together in the jaw. The symphysial region is flattened, both above and below, extending back to a line joining the pre-fossettes of P_4. (This character, although it has been given considerable weight in the past, is now regarded as varying with age and sex. It is not of value in separating Teleoceras from Aphelops.) The ramus increases in depth from P_3 to M_3, it is quite shallow beneath P_3; mental foramen large, beneath P_3, close to ventral border of ramus; rugosity on angle begins directly beneath ascending ramus and continues well around to the back of the jaw; post-cotyloid process broad but not especially heavy; condyle heavy, about as described by Lane (1927, p. 303) in his Paraphelops; coronoid broad at base, tapering to a rounded wide end, it is not "hooked" forward, but stands in line with the ascending ramus. The jaw is Teleocerine in all its characters, its robustness is, I believe, a sex character, and the prominence of the muscle attachments, rugosities and length of the symphysis is due to the age of the individual.

TABLE I

COMPARATIVE MEASUREMENTS OF TELEOCERAS FOSSIGER LOWER JAWS FROM FELDT RANCH

NAME	Lower Jaw length	Width across tusks	Width behind tusks	$P_{\bar{2}}-M_{\bar{3}}$	$P_{\bar{2}}-P_{\bar{4}}$	$M_{\bar{1}}-M_{\bar{3}}$	Length of symphysis	Depth below $M_{\bar{1}}$	Height: Angle to condyle	
Aphelops mutilus U.C.Mus.Pal #30252	600	130	125	318	144	174	196	125	296	
Teleoceras fossiger Ainsworth Nebr	530	104	95	253	85	170	128	84	200	
Teleoceras fossiger Ogallala, Nebr.	535	160	138	264	93	170	139	108	290	

MISCELLANEOUS RHINOCEROS MATERIAL

Besides the above-described jaw there are four separate Teleocerine teeth from this quarry. The two lower teeth (K. U. Mus. Pal. No. 3746) are molars quite like those of the jaw and may be referred to the same species. The two upper teeth (K. U. Mus. Pal. No. 3746) I believe to be the right M_1 and the left M_2, both heavily worn. So far as I am able to determine they may be identified with the *T. fossiger* skulls in the University of California Museum of Paleontology, but they are so heavily worn that specific reference is questionable. The remaining rhinoceros material, a tibia (K. U. Mus. Pal. No. 3751) and the right metatarsal IV (K. U. Mus. Pal. No. 3751A) are both distinctly Teleoceras. These limb elements are extremely short, and may be easily distinguished from the other rhinoceros genera of the Lower Pliocene.

Equidae

The remains of horses are the most common of all fossil vertebrates in the later Tertiary formations of the great plains. The beds at the type locality of the Ogallala are no exception in this respect. Horses in individual numbers were more abundant than any of the other animals. The material consists chiefly of teeth, only one lower jaw and several carpal and tarsal elements were found.

The genera represented are all Pliocene forms, the characteristic Miocene genus Merychippus is not present. The majority of these specimens are readily identifiable as members of the genus Hipparion, the most common of all Pliocene equine genera from these horizons. There are many species of this genus; some ten have been described from the general region in which this material was collected. When one works through this rather imposing list of species one finds most of them based upon poor material, insufficiently described, and distinguishable, if at all, only on the most meager characters. In working with such a list and attempting to identify any series of specimens, certain groups composed of several described species stand out quite clearly from each other. The species within these groups cannot, in my opinion, either be delineated or relegated to synonomy when a series of individuals is studied. These species represent variations, individual, geographic, or whatever one chooses to call them. It is true that certain specimens may be identified with certain of the described species, or perhaps one may view certain individuals as new species, yet the entire series seems to form a unit intergrading and combining at least four and perhaps six of the described "species." Matthew (1924, p. 154) encountered this same difficulty in working over the Snake Creek horses, and found it impossible to carry his identification further than these groups. Although I feel that these larger groups represent true species, until a larger series of topotype material has been collected from all localities I hesitate to throw any of them into synonomy. It seems best, therefore, to identify the horses as members of a group, giving it the name of the oldest described species within the range.

Hipparion occidentale (Leidy) 1856

(Plate XVII, figs. 1-2; Plate XVIII, fig. 1)

The *Hipparion occidentale* group was recognized by Matthew (1924, p. 172) who listed as other members of it, *H. affine, H. sinclairi,* and *H. whitneyi.* In addition to these the writer feels that *H. dolichops* Gidley and *H. coloradense* Osborn may also be members of this group. The above list of forms may all be characterized on the following points.

1. Medium sized to large hypsodont teeth.
2. Protocone separate from protoloph from crown to base.
3. Protocone flattened in an antero-posterior direction, but *not* extremely elongate.
4. Plication of the pli-prefossette and the pli-postfossette simple to moderately complex.
5. External styles of upper teeth heavy.
6. Pillars of metaconid and metastylid on the lower teeth rounded, equal in size, and close together, *not* flattened and far apart.

Description of the Ogallala Hipparion Material. The teeth (Plate XVII, fig. 1) from the Ogallala quarry are all quite hypsodont, nearly straight, and have a completely isolated protocone. The protocone is flattened in an antero-posterior direction, and in some cases is slightly concave on its lingual side. The enamel plications vary from a simple fold or two, to several folds, but in no case can they really be called "complex." The external styles are prominent on the upper teeth, showing no tendency to pinch in just above the bases. Unfortunately none of these teeth are associated, nor was there the slightest trace of any skull material. The above description is drawn from individual teeth, which are not complete in all cases.

The lower teeth are, in pattern, very close to Osborn's figure of the type of *H. whitneyi*. These teeth are quite hypsodont, large, and the crowns are only about one half longer than they are wide. The metaconid and the metastylid are rounded and not widely separated. The entoconid is crowded against the posterior border of the metastylid, but the protoconid and hypoconid are wide transversely.

Calippus sp?

(Plate XVIII, fig. 2)

Three of the equid teeth in the above series do not fall into the generic reference of the rest of the material. These three upper cheek teeth (K. U. Mus. Pal. No. 3790; Pl. XVIII, fig. 2) are smaller in size, less hypsodont, and the protocone is narrowly joined to the protoloph. These characters place them in the Pliocene genus Calippus, slightly larger than the genotype *C. placidus* (Leidy) from "the Lower Pliocene sands of the Niobrara River." These three teeth are intermediate in their characters between the genotype and *C. anse* from the Ogallala formation (Hemphill Beds) of Texas. The crown pattern is simple, without crenulations, and the premolars are, relative to those of Hipparion, less high crowned. Judging from these three teeth, the curvature is somewhat greater than that of Hipparion. This species may be distinguished from the genus Merychippus on the height of crown, simple, yet with an advanced crown pattern, and the lack of a pinching in of the mesostyle above the base.

? Pliohippus ?

Among the carpal and the tarsal elements which may be referred to the genus Hipparion is an exceptionally large astragulus. This element (K. U. Mus Pal. No. 3793) seems too large to be placed in the latter genus, and may possibly belong to the larger form Pliohippus. Members of this genus are common in faunas of this age, and especially so in the faunas of this region; its apparent rarity here may be regarded as exceptional.

ARTIODACTYLA

Prosthennops serus (Cope)

(Plate XIX; Plate XX, figs. 1, 2; Plate XXI, fig. 1)

The most complete material of all genera found at the Feldt Ranch locality was that of an extinct peccary. Unfortunately this group is not well enough known to be of much assistance in the correlation of these beds. However, since this material seems rather common in this region, a full description may, some day, make it useful. There are three species of the genus Prosthennops known from the plains Tertiary, and two species from the Pacific Coast, besides much referred material from both areas.

Prosthennops serus, the genotype, was collected by Russell Hill in 1872 from "the Loup Fork Beds of Northwestern Kansas." This specimen was very probably from the "Republican River Beds" of Osborn, and almost certainly from the Ogallala, which is the only known Tertiary formation in that area. This specimen, a lower jaw, was described by Cope under the name *Dicotyles serus*, although he probably realized that it was not a member of that genus. The second species was described in 1904 by Matthew and Gidley, who placed it in a new genus, Prosthennops, making Cope's species the genotype. This second species, *P. crassigens*, is based upon a very complete skull with heavily worn dentition. It was collected in the "Loup Fork Sands" of the Little White river, South Dakota, which at that time were considered Upper Miocene. In 1925 E. H. Barbour, of Nebraska State Museum, .published an account of a third species of Prosthennops. This form, *P. xiphidonticus*, was collected in 1915 "a mile or two west of Valentine, Cherry county, Nebraska." In this area Darton maps only Arickaree beds but, in my opinion, there are Pliocene beds here, either Ogallala or equivalent in age to this formation.

In addition there are two species known from the Pacific Coast, *Prosthennops edensis* Frick, of the Eden Pliocene, and *P. longirostris* Thorpe from the ?Pliocene deposits? of Oregon. Judging from the known occurrences of this form, as well as that of the referred material, it appears to be a Pliocene genus rather than a Miocene one as the original authors supposed.

Description of the Ogallala Peccary Material. The peccary material from the Ogallala type locality (Feldt Ranch Beds) may be referred to *Prosthennops serus* (Cope). The type of this species was described, but never figured, although many specimens have been referred to it. Dr. W. D. Matthew, who had access to this type, referred many of the Snake Creek specimens to it, and described the upper dentition and skull for the first time. On the above references and on Cope's original description I base my identification.

Lower Jaw. An adult lower jaw (K. U. Mus. Pal. No. 3755; Pl. XIX) with complete left dentition moderately worn. I_1 and I_2 pig-like, procumbent, of equal size; I_3 very small, separated from I_2 by one third distance to canine; canines missing, the alveoli indicating that they were large and projected slightly outward from mid-line of jaw; post-canine diastema long, equal to length of molar teeth, sharply ridged, straight except for slight incurve just behind canine, posterior end of diastema curves upward, slightly, to end of tooth row; P_2 triangular, small anterior tubercle, high median cusp, wide heel, which when unworn probably had two cusps; P_3 quite molariform, slightly wider posteriorly, two prominent anterior cusps, less worn than posterior pair; P_4 molariform, four main cusps, one at each corner; M_1 heavily worn, almost square with no trace of pattern except ridge across middle of tooth, dividing anterior and posterior set of cusps; M_2 larger with small cingulum across the anterior end of tooth, slight foreshadowing of heel on M_3; M_3 large, elongate, well-developed heel, with bases of three cusps, otherwise same as M_2. Jaw heavy and thick beneath cheek teeth, deep; symphysis as long as cheek-tooth row, suture shows plainly below, but is obliterated above. Jaw pinches in behind canines, expands rapidly from that point back; posterior part of ramus missing. Entire specimen large and heavy in general build.

TABLE II

COMPARATIVE MEASUREMENTS OF PROSTHENNOPS SERUS FROM FELDT RANCH

NAME	$P_{\bar{2}}-M_{\bar{3}}$	$P_{\bar{2}}-P_{\bar{4}}$	$M_{\bar{1}}-M_{\bar{3}}$	Diastema length	Width across canines	$P_{\bar{2}}$ length	$P_{\bar{3}}$ length	$P_{\bar{4}}$ length	$M_{\bar{1}}$ length	$M_{\bar{2}}$ length	$M_{\bar{3}}$ length	Depth of ramus below $P_{\bar{3}}$
P. serus Ogallala specimen	988	392	59.7	534	18	11.1	12.3	14.3	14.0	19.2	26.4	43.6
P. serus Snake Creek			57.6					15.9	17.7	18.7	23.4	
P. longirostris Type	96.5	46.5	60.	76.5	34.	10+	11.6+	15.4+	16.2+	18.8+	24.2+	48.4+
P xiphidonticus Type	75.	29.	46.	37.			9.2	12.2	12.6	14.3	18.8	34.
P crassigens Snake Creek	85+	32+	56.6			8.5+	10.5+	13.2+	13.5+	16.5+	23.1	35.2

Milk Dentition. A fragment of the right lower jaw (K. U. Mus. Pal. No. 3753; Pl. XX, fig. 1) is the milk dentition of this form. Dp_2 posterior half only, stands well out of the jaw, high median cusp and low posterior one. Dp_3 also high out of alveoli, two small anterior cusps, larger median cusp with a trace of bifurcation (in unworn stage), low posterior heel which probably carried only one cusp and a cingulum. Dp_4 large, oblong, "double" tooth, with three transverse rows of cusps made up of two each; this tooth is slightly wider posteriorly, carrying a small accessory cusp (in mid-line) between the two posterior main ones, also has a trace of a cingulum at that point.

Upper Permanent Dentition. Unfortunately the parts of the skull represented in our collection are not diagnostic of the species. There are two specimens showing the upper dentition, but the permanent premolars are not present in either. In one of these two (K. U. Mus. Pal. No. 3754; Pl. XX, fig. 2) a section of the posterior part of the palate with M_1 and M_2 in place, P_3, P_4, and M_3 may be readily seen, but are not yet functional. P_3 is a square tooth (12.4 long by 12.4 wide) whose height of crown is about as great as its own length (11.0). There are two main cusps on the posterior half of the crown, two smaller cusps anterior to the main ones and crowded to the lingual side, and on the buccal and anterior edge of the tooth a well-developed cingulum is present. P_4 is one third larger than P_3, with four prominent cusps on its crown. There is a trace of a cingulum on the anterior margin of this tooth. M_1 is oblong in shape (16.0 by 13.4) with marked anterior and posterior cingula, which may be carried entirely across the exterior of the tooth in some specimens. It bears four heavy, blunt cusps and two median accessory cusps on the anterior side of the two main sets. M_2 is one third larger than M_1, with a rather square crown (19.4 by 17.0). The posterior and anterior cingula are not well developed, and the tooth bears three accessory cusps; one on the anterior cingulum in the mid-line, one between the posterior main cusps as in M_1, and a third, less well developed, on the posterior cingulum at its mid-point. The four main cusps are slightly heavier than in M_1. M_3 is unerupted, and is, therefore, somewhate obscure. It appears to be a square tooth, with four main heavy cusps and several minor ones. It is distinctly larger and more high crowned than are the other teeth of the series. There is no indication of cross-cresting in these specimens, such as one finds in the genus Platygonus.

Upper Deciduous Dentition. The deciduous teeth are well preserved in the larger part of the rostrum of a skull (K. U. Mus. Pal. No. 3753; Pl. XXI, 1). The anterior tip of the palate is broken away just anterior to the canines, but both maxilla are complete back to and including M^1. The deciduous canines are still in place, but the permanent ones are developed, and may be seen just anterior to and below those now in use. The post-canine diastema (38.4) is about equal to the length of the premolar teeth (39.0). Dp^2 is a small (10.6 by 7.6), triangular, three-rooted tooth, with a prominent, anterior, bifurcate cusp, and two posterior cusps wide apart and low. The posterior half of this tooth carries a cingulum. Dp^3 is one third larger than Dp^2 (13.4 by 11.0), and its anterior cusps are only slightly larger than the posterior set. It bears a cingulum across the posterior half of the crown, and is slightly wider in that region. Dp^4 foreshadows M^1, the cingulum is almost complete on the buccal side of the tooth, and the anterior and posterior sets of cusps are of equal size. The entire series of upper deciduous teeth show a decided tendency toward the formation of accessory cusps.

The skull parts represented in the above specimens are in most respects the same as those of either *P. serus* or *P. crassigens*. The skull of the latter species is fairly well described, but Matthew (1924, p. 178) did not figure or give measurements of the skull which he referred to *P. serus*. The points of difference on which these two species are based have not been clearly set forth.

RELATIONSHIPS OF THE OGALLALA PECCARY MATERIAL

As shown above, the Ogallala peccaries fall into the fairly well-known *P. serus-P. crassigens* group. They were collected just north of the type locality of the former species, and may, I think, be definitely referred to it. The Valentine form, *P. xiphidonticus,* is a smaller and more primitive member of the genus, the I_3 is larger, P_2 and P_3 are less molariform, and the heel of M_3 is not as well developed. In general outline the lower jaw of *P. xiphidonticus* is similar to *P. longirostris* of the Oregon Pliocene. The California species *P. edensis* is so heavily worn and fragmentary that little may be told about it.

CAMELID

Two teeth, an incisor and an upper molar, are camelid but are further indeterminate. At least two genera are represented in this meager lot of material. The incisor is large, quite spatulate, and belongs to an advanced form of camel very distinct from the form represented by the molar tooth. The upper molar is of a low crowned form, with prominent external styles and represents the left M_2. It belongs to one of the more primitive camelid genera, possibly Miolabis or Protolabis, but lack of additional evidence makes such a reference little better that a guess.

? BLASTOMERYX

(Plate XXI, fig. 2)

The anterior part of the right lower jaw of a tiny cervid (K. U. Mus. Pal. No. 3148; Pl. XXI, fig. 2) represents one of the rarer genera of the Pliocene faunas. The teeth (P_2 to M_1) are heavily worn and little can be told about them, except that in size, pattern and general proportion they are close to Blastomeryx. The Blastomeryx group is well represented in the Miocene deposits of the great plains, but by Pliocene time it seems to have largely disappeared. Of the eight small species of the genus Blastomeryx, only two are recorded from the Pliocene. It is with these two small, advanced species that the Ogallala specimens may be placed.

PROBOSCIDEA—MASTODONTIDAE

(Plate XXII, figs. 1, 2)

Two specimens in this collection are of especial interest, since they represent a foetal or very young proboscidean. I am unable to say to which of the groups under the family this form belongs, since it does not exhibit any adult characters. The first of these two specimens (K. U. Mus. Pal. No. 3758; Pl. XXII, 1) is the posterior part of the right maxillary with two teeth in place. The most anterior of these teeth has lost its crown, and might easily be mistaken for a heavily worn tooth, since its surface is flat and presents no characters. The most posterior of the teeth has a well-developed crown with its anterior inner tip broken away. This tooth is placed at an angle of almost 45° with the mid-line of the jaw, and it slightly overlaps the posterior outer margin of the most anterior tooth. The pattern of the cusp of this second tooth resembles in a general way that of the other members of this family from the same horizon. The angle of this tooth to the mid-line and the fact that the anterior inner base projects through the wall of the jaw leads one to suspect that the specimen is abnormal. It is approximately half the size of the foetal form of *Platybelodon grangeri* recently described by Osborn and Granger (1932, p. 5) from the Miocene Tung Gur beds of China. The second specimen (K. U. Mus. Pal. No. 3758; Pl. XXII, fig. 2) I identify as the superior milk incisor. This tooth is less than half the size of the form referred to by Osborn and Granger. The tooth is oval in cross section, becoming quite flattened at its root. The anterior tip is coated with enamel which fades away one fourth the distance from the anterior tip. The tip of the tooth is slightly curved downward. On the anterior tip, and just at the base of the enamel line on the inner side, this tooth shows wear. The tip is blunted, and the posterior wear spot is quite pronounced. I cannot explain this wear on any other grounds except from use of the tooth; this, of course, makes it impossible that the individual was yet unborn. Although less than half the size of the Chinese specimen, which is considered as foetal, this tiny proboscidean must have been fully developed and capable of feeding by itself.

CORRELATION

OF THE FOSSIL VERTEBRATES OF THE TYPE LOCALITY OF THE OGALLALA FORMATION

As has been pointed out in the introduction of this report, the Ogallala formation has a very wide geographical extent. It includes many so-called "formations" and "beds" which have been named chiefly by vertebrate paleontologists, and the application of which is quite local.

Within the areal limits of Darton's Ogallala, several vertebrate faunas are known. These fall clearly into two groups; first, an older one characteristic of the formation as a whole, and allied to that of the type section; and second, a much younger assemblage, probably confined to the loess of Pleistocene time.

In the first, which is the older of these two groups, and typical of the Ogallala as a formation, we may place the faunas found at the following localities:

1. Feldt Ranch fauna, referred to in this report as such from the type locality of the Ogallala formation, Keith county, Nebraska.

2. Republican River fauna. The entire Republican River fauna has been referred to the "Republican River Beds" of Osborn (1910, p. 348). This formation has never been defined in any accurate way, nor have geologists working in that region recognized any such unit. The fossils were collected over a considerable area, on several different creeks both in Kansas and Nebraska. Some of these localities are as much as 150 miles apart. Condra (1907, p. 19) has pointed out the possibility of outliers of Arickaree in this area, and Matthew (1930, p. 359) and others have called attention to the probability of two faunal assemblages occurring here. Therefore we may regard this fauna as:

a. An older phase, probably confined to certain localities within the area from which the collections came.

b. A younger phase, equivalent to the fauna of the Ogallala type locality, and embracing most of the Republican River fossils.

3. The Edson fauna, from the "Edson Beds" of Adams and Martin (1929, p. 505), in the southeast corner of Sherman county, Kansas.

4. The "Rhinoceros Hill" fauna, from the "Rhinoceros Hill Beds" of M. K. Elias (1931, p. 159), in the northeastern corner of Wallace county, Kansas.

5. The Collins Draw fauna, from Ogallala beds which have no local name, in the western part of Wallace county, Kansas.

6. The Beecher Island fauna, from the "Wray Beds" of Cook (1922, p. 4), south of the town of Wray, Yuma county, Colorado.

7. The Beaver fauna, from Ogallala beds, with no local name, 10 miles east of the town of Beaver, Beaver county, Oklahoma.

8. The Optima fauna, from Ogallala beds, near the town of Optima, Texas county, Oklahoma.

9. The Hopewell fauna, from Ogallala beds, with no local name, east of Higgins, Texas, near Hopewell Schoolhouse, Ellis county, Oklahoma.

10. The Higgins fauna, from Ogallala beds, near Higgins, Lipscomb county, Texas.

11. The Hemphill faunas, from the "Hemphill Beds" of Reed and Longnecker (1932, p. 18), in Hemphill county, Texas.

12. The Clarendon fauna, from the "Clarendon Beds" of Gidley (1903, p. 632), near the town of Clarendon, Donley county, Texas.

13. The Blanco fauna, from the "Blanco formation" of Cummins (1890, p. 431; 1893, p. 200), from beds overlying the section of the Dockum conglomerate, in Dickens county, Texas.

Most of the above faunas are of about the same age, but certain differences in them are apparent. The most primitive vertebrate fossils found in any of the above-listed localities occur in the older phase of the Republican River fauna (Republican River A). The Miocene genus Merychippus is recorded in this fauna from Driftwood Creek, Nebraska; from Plum Creek, Kansas; and from the region south of the town of Logan, Kansas. As has been pointed out by Matthew (1930, p. 359) and others, there certainly are two faunal phases represented in this collection of material. It may be that small outliers of Arickaree do occur in this area, or perhaps we are dealing with a somewhat transitional fauna. The species *M. republicanus* is certainly a well-advanced form, and represents an end product of the evolution of that genus. The only other record of Merychippus within the above list of faunas is that of two teeth from the Beecher Island fauna (Wray Beds). H. J. Cook (1922, p. 10) points out in his paper that the teeth resemble Pliohippus in many ways. The distinction between these two genera is often difficult to make, and after a study of Cook's figures of the teeth, the weight of the evidence is, in my opinion, in favor of their being *Pliohippus*.

Other than the Republican River phase A. fauna, the Clarendon of Texas contains the most primitive types, but the assemblage is characterized by the genus *Hipparion*. Very close to the Clarendon vertebrates in their degree of "advancement" are the equids of the Beaver fauna.

The remaining faunas, with the exception of the Blanco, are approximately the same age, and appear to be characteristic of the formation. These faunas are separated, if at all, only by the smallest gaps, and are in the main typical middle Pliocene assemblages. The Blanco fauna, from the Blanco formation of Cummins (1890, p. 431; 1893, p. 200), is the most advanced of all groups in the list, so much so that it is generally considered the youngest Pliocene fauna of the great plains area.

The most primitive fauna in the above list is that of the Republican River phase A. Although the genus Merychippus does not occur in the old world, I believe the remainder of the fauna to be about the same age as the Tung Gur of China, the Chingi of India and the La Grive-Saint Alban of Europe. The Clarendon and Beaver material is allied more closely with the Pikermi and Samos faunas of Europe. They are regarded in this report as of lower Pliocene age.

The slightly younger group, more common in the entire formation, is middle Pliocene, comparable to the Montpellier and Roussilon Pliocene Beds of Europe. The entire list of faunas is close to those found in the lower parts of the Loess of China, which are regarded there as being Pontian in age.

The second series of vertebrate faunas which are found within the areal extent of the Ogallala, are of Pleistocene age, and are not regarded as a part of the formation. Although the beds from which these fossils come are of later date than the Ogallala, in many localities it is difficult, if not impossible, to draw a line between the two. The Pleistocene probably does not have a wide areal extent as a stratigraphic unit, but apparently is of local occurrence. Many names have been suggested for these beds, but few of them have been sufficiently well founded to be of use. The Sanborn formation (Elias 1932, p. 163) is probably the best defined of all, and should supplant the use of the host of older names. This formation is not fossiliferous at all points, but in some localities large quantities of material have been found. The following notable occurrences of vertebrates may be referred to these beds:

1. *Elephas.* The "Elephas Quarry" worked by C. H. Sternberg, seven miles northeast of Pendennis, Lane county, Kansas.

2. *Platygonus leptorhinus*, several skeletons obtained by S. W. Williston, at Goodland, Sherman county, Kansas.

3. *Bison occidentalis.* H. T. Martin obtained seven skeletons on Twelve Mile creek, east of Russell Springs, Logan county, Kansas.

4. *Bison occidentalis.* H. T. Martin obtained many hundred teeth and skeletal elements, seven miles east of Atwood, Rawlins county, Kansas.

5. A Pleistocene fauna, collected in Clark and Meade counties, Kansas. Reported on by Cragin (1896) and O. P. Hay.

In addition to the above important occurrences of Pleistocene vertebrates, there have been many hundred individual specimens found in this region, most of which have been listed by Hay (1924).

The question of the mode of deposition (see Hatcher, 1902, and Baker, 1915) and the formational continuity of the Ogallala I leave to the geologist. In an area so large and a unit in which the sequence is so indefinite one might question the reference of the entire series to one formation. So far as I am able to determine there is no satisfactory indication that the Ogallala should be subdivided. If such a step be taken in the future, it would be necessary to keep the Clarendon and Beaver faunas in the oldest subdivision and Blanco fauna in the youngest. Texas, then, seems to contain the most complete section, and here, possibly, may be found the solution of many of the problems suggested by this formation.

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PLATE XV

FIG. 1. *Dipoides sp?* Upper cheek tooth, twice natural size, crown lingual and labial view. Arrow indicates anterior side.

FIG. 2. *Felis sp?* Fourth metatarsal, K. U. Mus. Pal. No. 3759, natural size.

PLATE XV

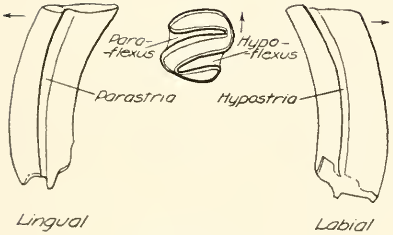
Para-flexus
Hypo-flexus
Parastria
Hypostria
Lingual
Labial

FIGURE 1

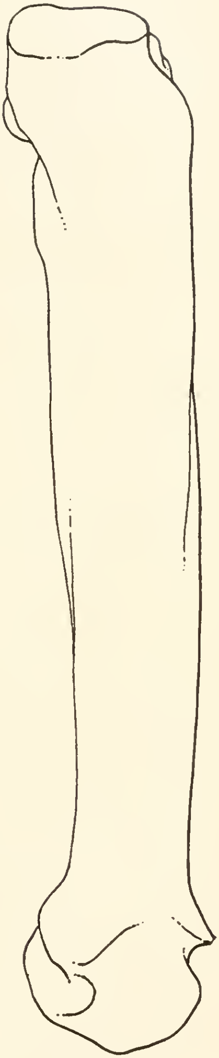

FIGURE 2

PLATE XVI

Teleoceras fossiger. Lower jaws, K. U. Mus. Pal. No. 3752, approximately one third natural size. See table in text for exact measurements.

PLATE XVI

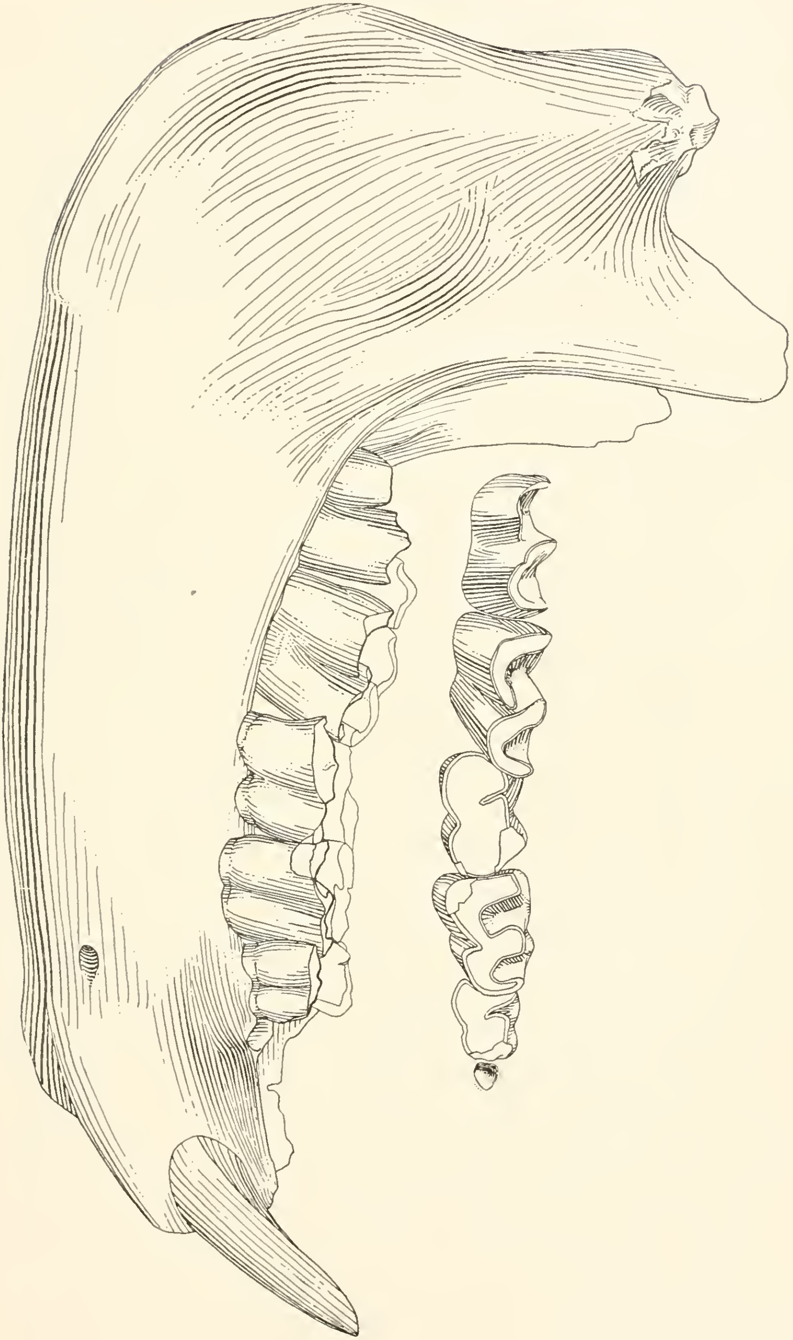

PLATE XVII

FIG. 1. *Hipparion occidentale.* Three upper cheek teeth, K. U. Mus. Pal. No. 3792. A. Crown and anterior side. B. Crown and lingual side. C. Crown and labial side.

FIG. 2. *Hipparion occidentale.* Left lower cheek teeth, K. U. Mus. Pal. No. 3744, crown view, natural size.

PLATE XVII

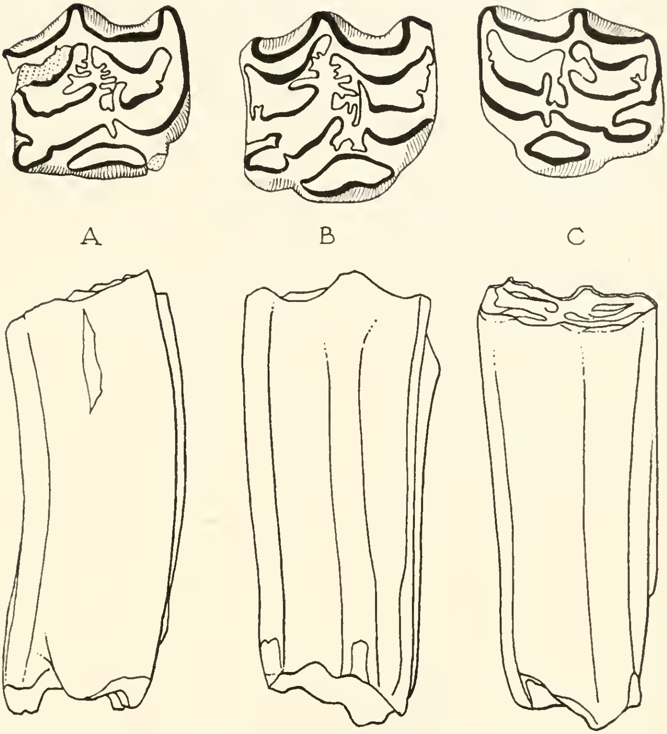

Figure 1

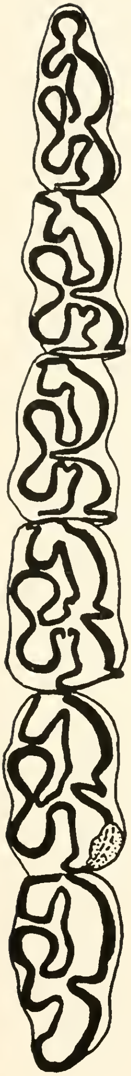

Figure 2

PLATE XVIII

FIG. 1. *Hipparion occidentale*. Three lower cheek teeth, K. U. Mus. Pal. No. 3791. Crown and lingual view, natural size.

FIG. 2. *Calippus sp?* Two upper cheek teeth, K. U. Mus. Pal. No. 3790. A. Crown and lingual view. B. Crown and labial view.

PLATE XVIII

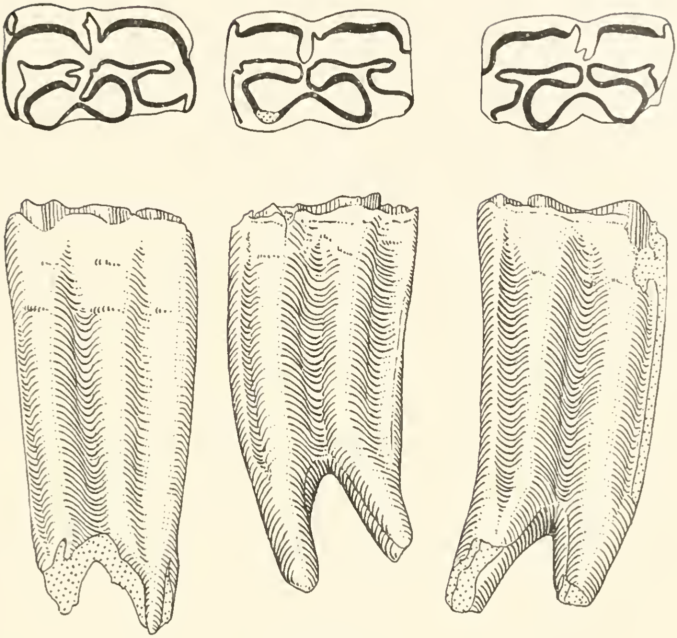

FIGURE 1

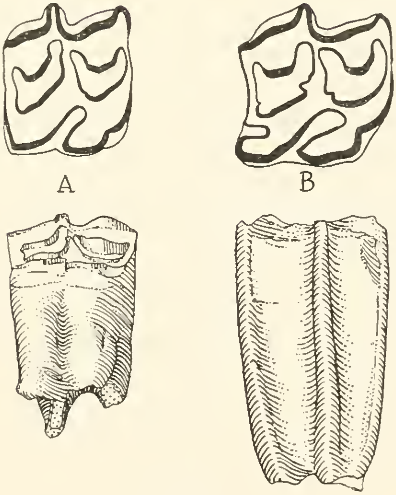

FIGURE 2

PLATE XIX

Prosthennops serus. Incomplete lower jaws, K. U. Mus. Pal. No. 3755, P_2 to M_3 crown view of cheek teeth and side view of jaw. Approximately three fourths natural size. See text for measurements.

PLATE XIX

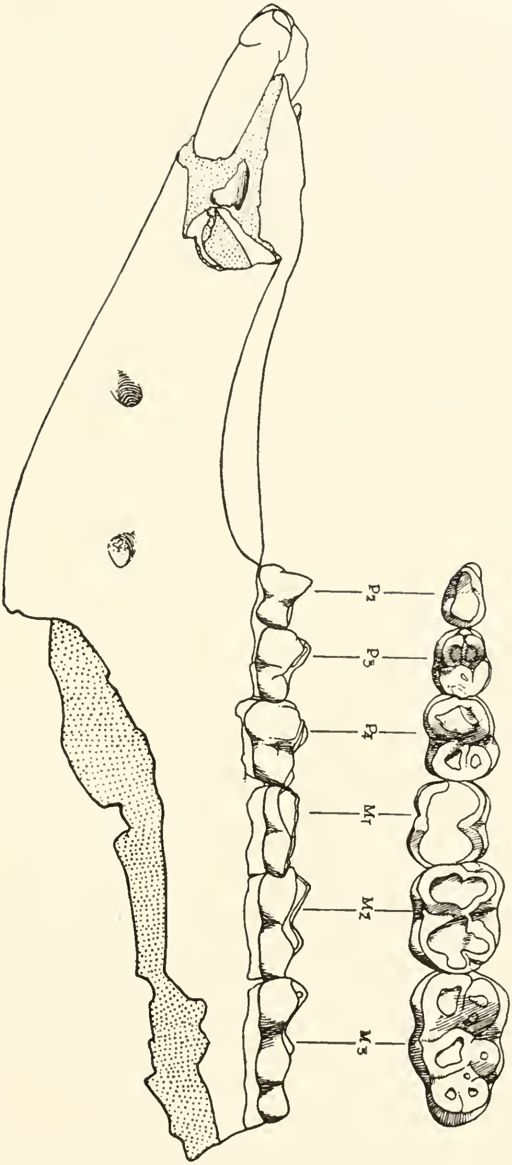
P_2
P_3
P_4
M_1
M_2
M_3

PLATE XX

FIG. 1. *Prosthennops serus.* Fragment of right lower jaw, K. U. Mus. Pal. No. 3753, Dp_2 to M_1, natural size. A. Crown view of teeth. B. Side view of jaw.

FIG. 2. *Prosthennops serus.* Part of palate of skull, K. U. Mus. Pal. No. 3754, P_3, P_4 unerupted, M_1, M_2 in place and M_3 unerupted, natural size.

PLATE XX

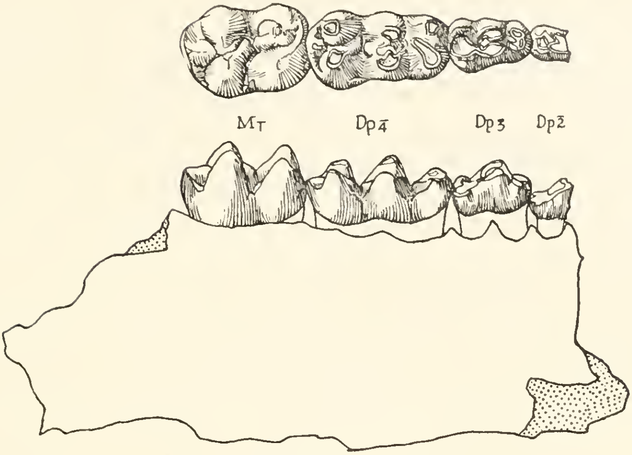
M1
Dp4
Dp3
Dp2

FIGURE 1

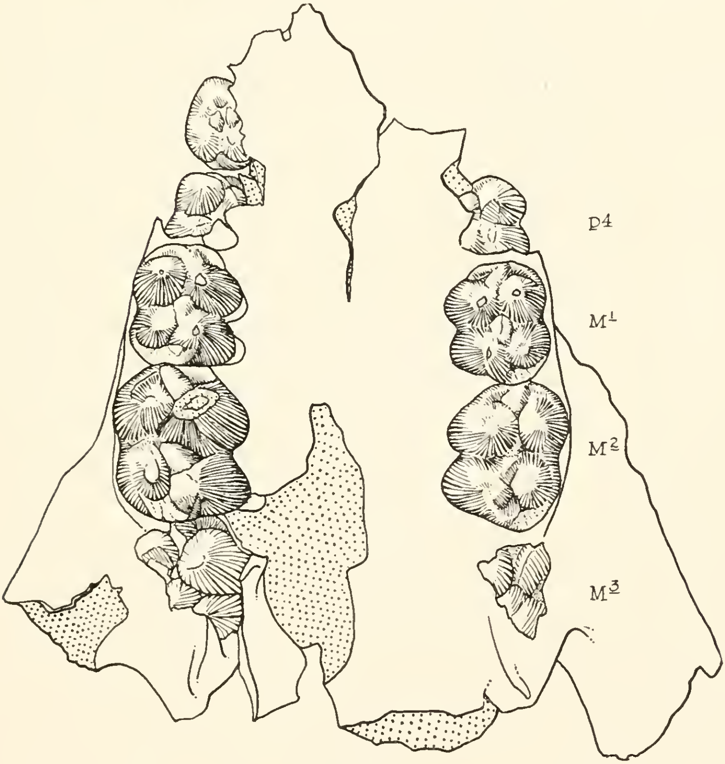

FIGURE 2

PLATE XXI

FIG. 1. *Prosthennops serus.* Palate of skull, K. U. Mus. Pal. No. 3753, associated with lower jaw fragment (Pl. XX, fig. 1), Dp_2-M_1, natural size.

FIG. 2. *Blastomeryx sp?* Anterior part of right lower jaw, K. U. Mus. Pal. No. 3748, P_2-M_1, natural size.

PLATE XXI

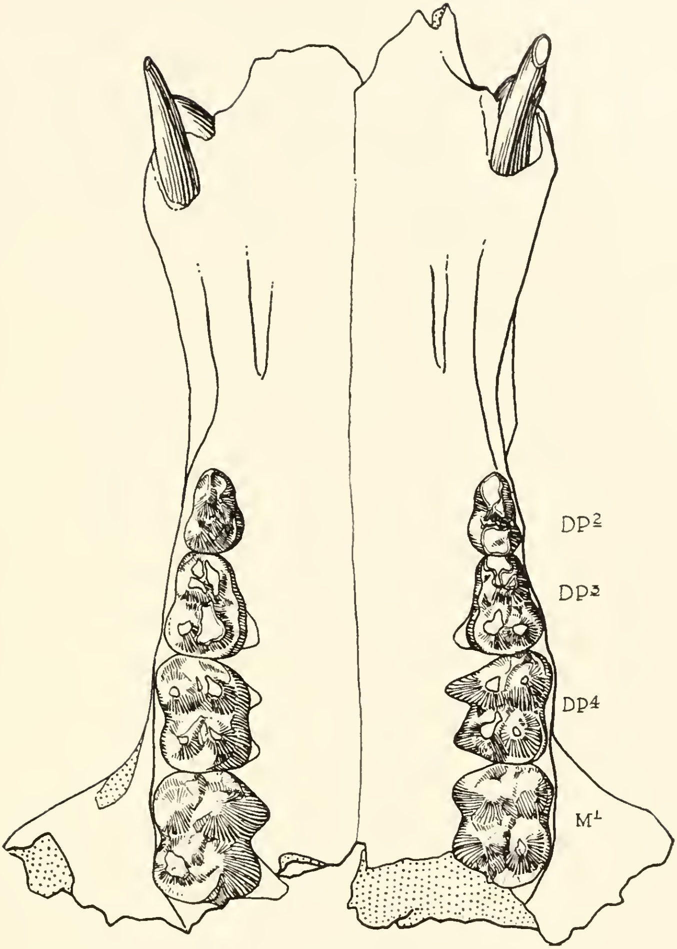
DP2
DP3
DP4
M1

FIGURE 1

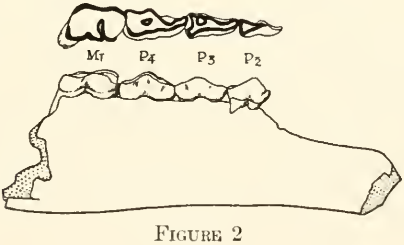

FIGURE 2

PLATE XXII

FIG. 1. *Mastodontidae.* Fragment of the right maxillary of immature or foetal form. K. U. Mus. Pal. No. 3758, natural size.

FIG. 2. *Mastodontidae.* Superior milk incisor of immature or possibly foetal individual, K. U. Mus. Pal. No. 3758, natural size.

PLATE XXII

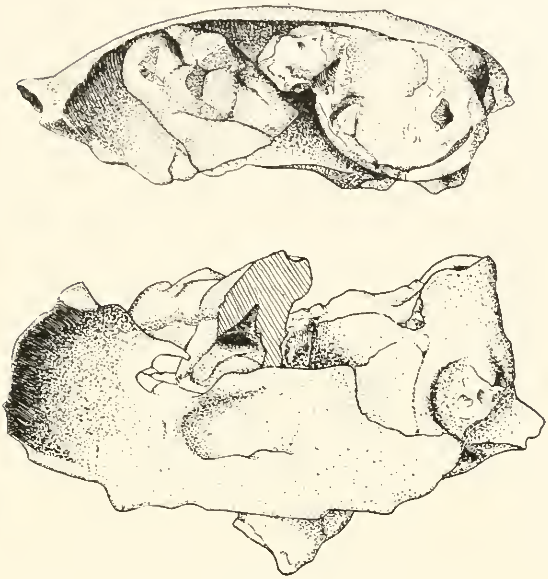

Figure 1

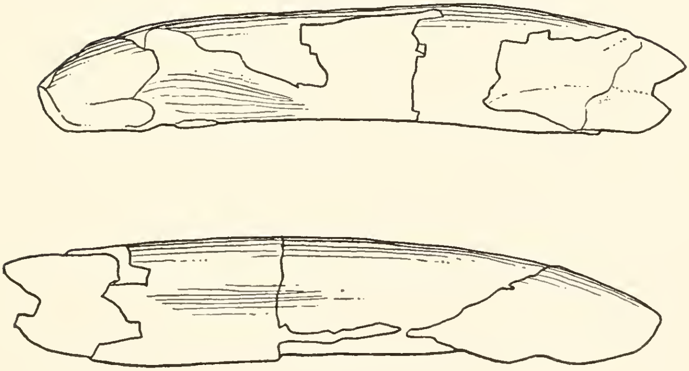

Figure 2

THE UNIVERSITY OF KANSAS
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Miscellaneous Notes on Mexican Lizards

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ABSTRACT: The study is based upon the material secured in Mexico in the collections of Edward H. Taylor, David H. Dunkle and Hobart M. Smith. Notes are given on *Hemidactylus turcicus, Iguana rhinolopha, Ctenosaura pectinata, C. acanthura, C. similis, C. hemilopha, Basiliscus vittatus, Crotaphytus collaris collaris, C. wislizenii, Phrynosoma cornutum, P. modestum, Ameiva undulata undulata, Heloderma horridum* and *Anelytropsis papillosus. Phyllodactylus lanei* and *P. homolepidurus* are described as new.

THE following notes are based upon the specimens of certain miscellaneous genera of lizards contained in three collections from Mexico: One secured during the summer of 1932 by Dr. Edward H. Taylor and myself, another during the summer of 1934 by Mr. David H. Dunkle and myself, and the other during the summer of 1934 by Doctor Taylor (specimens in these collections indicated by EHT and HMS, DHD and HMS, and EHT, respectively).

I wish here to express my appreciation for the aid received, in the collection and study of this material, from Dr. Edward H. Taylor, Mr. David H. Dunkle, Mr. C. D. Bunker and Dr. H. H. Lane. I am further indebted to Mr. L. M. Klauber, who has loaned specimens of Phyllodactylus from the United States and Baja California; to Dr. Leonhard Stejneger, who has given notes from the log of Meyen's "Reise um die Erde" relative to the type locality of Meyen's *Phyllodactylus tuberculosus;* to Dr. J. W. Bailey, who has kindly examined and offered his opinion concerning the identity of some of the Ctenosaurs; and to Mr. J. C. Bay, of John Crerar Library, for his kindness in loaning necessary reference works. The study has been aided by a grant from the University of Kansas graduate research fund.

PHYLLODACTYLUS

Phyllodactylus tuberculosus was described by Wiegmann in 1835 in a discussion of the herpetological material collected by Meyen on his Reise um die Erde. The locality from which the specimen came was given as "Californien."

It has generally been accepted that "Californien" was the territory now known as either the state of Baja California, in Mexico, or the state of California, of the United States, in which region there actually exists at least one form of Phyllodactylus to which Weigmann's name has been applied. However, there are a number of important facts which show that this interpretation cannot be correct.

In reply to an inquiry from Doctor Taylor, Doctor Stejneger has stated (in letter) that, according to the log of Meyen's trip, "the *Prinzess Louise* did not touch in California at all. She sailed directly from Hamburg to Rio de Janeiro and from there to Valparaiso. From there Meyen visited Santiago and undertook an excursion to the province of Colehagua, left Santiago February 2, 1831, ascended Monte Impossible and returned to Santiago on February 11. Another excursion to the volcano Maipú, February 14, and back in Valparaiso February 25. *Prinzess Louise* left Valparaiso March 6. On March 8 Meyen was ashore at Coquimbo, and on March 11 at Copiapó, making from here an excursion to Nantoko and La Punta, back in Copiapó March 19. *P. L.* left next day for and arrived in Arica, Peru, March 26. From here Meyen traveled over Tacna to Lake Titicaca, arriving April 7. Returned over Arequipa, arriving in Islay April 23, joining the *P. L.* in Callao April 28. From May 4-16 in Lima, with short excursions in the surrounding country. The *P. L.* left Callao May 21 directly for Honolulu, arriving there June 24, 1831. Left Honolulu direct for Canton, China, without touching land. Arrived in China August 13.

"Neither the *Prinzess Louise* nor Meyen visited California nor any other American port north of Callao.

"I have glanced through the text of Meyen's account of the journey, but have found no reference that would throw any light on the type locality of *Phyllodactylus tuberculosus.*"

It may be added that, were this type locality the California of North America, it would be the only locality in North or Central America mentioned by Weigmann in his whole paper. It would seem almost beyond doubt that "Californien" must refer to some small village near one of the ports Meyen is known to have visited.

Moreover, the original description of *P. tuberculosus* differs widely from the characteristics of specimens available from the United States and Mexico, including Baja California. It has appeared, from the study of this material, that the name *tuberculosus* must be applied to the South American and possibly also to the Galapagos Islands form, which has been known by that name; previously confused with this species are at least two others, one of which is a distinct tropical form existing in Mexico and possibly Central America, the other, equally distinct and desert-inhabiting, occurring in Sonora and, probably, southern California and Baja California. The latter two species are described below.

Phyllodactylus homolepidurus sp. n.

(Text fig. 1A; Plate XXV, fig. 2)

Type. Male, EHT No. 146, collected five miles southwest of Hermosillo, June 22, 1934, by Edward H. Taylor.

Paratypes. Twenty-five, including eleven collected with the type (EHT Nos. 125-127, 144, 145, 147-149, 149a, 150, 151); eleven from a locality 10 miles northwest of Guaymas, June 28 to July 9, 1934 (EHT Nos. 221, 225, 272, 273, 302, 303, 384, 384a, 384b, 515, 516); and three taken 4 miles southeast of Guaymas, on Empalme road, July 13, 1934 (EHT Nos. 518-520). All collected by Edward H. Taylor.

Diagnosis. A Phyllodactylus attaining a maximum snout to vent length of 65 mm. to 70 mm.; occipital scales granular, about equal in size to those on body; interorbital scales considerably smaller than median scales in frontonasal region; no row of scales following postmentals; six or seven upper labials to a point below the middle of the eye; scales of body small but squamous and definitely imbricate; tubercles on body very low, keeled, round or oval; no tubercles on humerus, rarely a few on femur; two or three rows of low, weakly keeled scales on each side at base of tail, decreasing distally to one row on each side of flat, smooth, scarcely enlarged scales, which disappears at about half the distance between the base and distal end; scales granular on posterior surface of femur and dorsal surface of tibia; cloacal bones of males with the median termination in the form of two somewhat spherical lobes whose median axis is at right angles to the plane of the remainder of the bone; tail with indistinct bands of darker gray; dark gray or slate-black crossbars on back, usually interrupted medially by a light line passing from occiput to base of tail; ventral surfaces usually very lightly stippled with black, rarely stippled sufficiently heavy to be visible to the naked eye.

Description of Type. Head flattened; dorsal profile (lateral view) of head a straight line from orbit to snout, the orbits very slightly projecting, the occipital region not elevated, almost parallel with axis of body; snout rounded; sides of head (dorsal view) smoothly rounded from orbit to snout; jaws slightly constricted at level of orbits; frontonasal groove rather shallow; loreal region weakly concave, at an angle of about 45° with the horizontal; interorbital scales in about eleven rows, about one third the size of the median scales in the frontonasal region and about equal in size to the granular scales of occiput and body; numerous very small, conical or rounded tubercles scattered over occipital and temporal regions; about eleven upper labials, six or seven to a point below middle of eye; six or seven lower labials to a point below middle of eye; rostral about twice as broad as long, rectangular, partially split in the posterior median line, its postero-lateral corners in contact with nares; two internasals, in contact medially, irregular in shape, about as long as broad; mental large, definitely triangular, its labial border about one fourth greater than that of rostral; mental followed by two large, oval postmentals, narrowly in contact on the median line, and bordering the first labial laterally; scales following postmentals irregular, larger than median gulars, into which they grade; gulars small, merging with the abdominals in the cervical region; granules on body smooth, flat, imbricate; maximum of eight irregular, longitudinal rows of enlarged tubercles on each side of back; tubercles low, weakly keeled, oval and slightly trihedral on eight median rows; lateral tubercles more rounded, sharply truncate on posterior end and slightly more elevated, not conical; tubercles on neck low, rounded, convex, not keeled or conical; scales of anterior surface of upper foreleg about three fourths the size of ventral abdominals, somewhat smaller on posterior and dorsal surfaces; ventral scales of upper foreleg granular; scales on anterior surface of lower foreleg slightly smaller than ventral abdominals; those on dorsal surface of the same member granular, with a few scattered, conical, enlarged tubercles; ventral scales of lower foreleg very small, but squamous; lamellar formula for fingers (to bases and excluding terminal lamella): 6-9-11-12-9, at least the distal lamella, in all cases, divided; scales on anterior and ventral surfaces of femur squamous, the latter smaller than the former and of approximately the same size as the ventral abdominals; scales on dorsal and posterior surfaces of femur very small, without enlarged tubercles intermixed; ventral scales of tibia slightly smaller than ventrals on femur; scales on anterior surface of tibia slightly smaller than the ventrals of the same member; dorsal scales of tibia very small, with scattered, enlarged, rounded, conical or convex tubercles; no tubercles on dorsal surface of foot; lamellar formula for toes (to bases and excluding terminal lamella): 6-10-13-14-12; at least the distal lamella, in all cases, divided; scales in axilla and groin, above insertion of foreleg and behind and above insertion of hindleg, very small or granular; coacal wall produced backward, in the median ventral line, only very slightly; on each side of the median line, at the base of the tail and near the anus, is a narrow, transverse pore opening into a sac below the cloacal bone, but not connected with the hemipenis; four slightly enlarged scales in an oblique row immediately behind insertion of hind leg and near anus; four dorsal rows of enlarged, smooth or very weakly keeled scales continued onto base of tail, disappearing entirely a few millimeters beyond base; scales on remainder of tail smooth, small, imbricate, in regular annuli; a series of large, transverse subcaudals extending the full length of the tail, divided near proximal end of tail, irregularly broken near anus.

Ground color above almost white; a distinct dark-gray line from snout through middle of orbit to upper margin of ear; a few irregular, grayish markings in temporal and occipital regions; a series of about eight irregular, gray crossbars on back from scapular region to base of tail, these bifurcating on the sides; tail with broad, dim rings of gray, slightly darker posteriorly, alternating with rings of whitish; hind limbs irregularly marked with gray; forelimbs dimly banded; venter whitish, immaculate except for fine stippling of black, practically invisible to the naked eye; stippling more concentrated on ventral surfaces of tail and hind limbs.

The cloacal bones are curved, flattened in a horizontal plane at the outer end, gradually twisting toward the median line. The median end is in a vertical plane and is modified into the form of a bilobed spheroid. The bone curves about the postanal pore of the corresponding side.

Variation. The scale characters are constant for the most part. The mental is frequently pentagonal instead of triangular; the postmentals may or may not be separated on the median line by an azygous scale. The tubercles on the nape may be smooth, conical or weakly keeled; the tubercles on the body are always small, low and

Measurements and scale counts of *Phyllodactylus homolepidurus*

Number	381	273	147	519	518	225	146	515	144	149	516	145	415b	148	415a
Sex	♂	♂	♂	♂	♀	♂	♂	♀	♀	♂	♀	♂	♀	♀	♀
Snout to vent	46.0	47.0	48.5	49.5	54.0	51.5	55.0	58.5	58.5	58.6	60.0	60.0	62.5	65.0	67.5
Snout to ear	11.0	12.0	12.5	12.6	13.3	13.0	12.5	14.9	14.5	14.0	15.0	14.8	14.6	15.0	16.0
Head width	9.7	10.0	10.8	11.0	11.0	11.4	11.5	12.3	12.8	12.7	12.8	12.6	12.0	12.8	14.2
Snout to orbit	5.6	5.7	5.8	5.5	6.8	6.0	6.0	6.9	6.5	7.0	7.2	7.0	7.0	7.2	7.8
Diameter of orbit	3.0	3.2	3.1	3.3	3.4	3.4	3.0	3.5	3.1	3.6	3.7	3.2	3.6	3.5	3.9
Foreleg	15.0	15.0	16.0	17.0	18.2	18.2	17.5	19.5	20.1	19.0	20.0	21.0	21.0	21.0	21.5
Hindleg	21.0	20.5	22.5	20.7	23.0	23.5	23.0	27.5	26.5	26.0	....	26.7	28.5	27.2	28.1
Fourth toe	5.1	6.0	6.3	6.0	7.6	6.2	6.3	6.9	7.1	7.0	6.9	7.0	7.5	7.2	7.6
Upper labials*	6-6	6-7	6-6	6-7	7-7	7-7	6-7	7-8	7-7	6-7	7-6	7-7	7-7	7-7	7-7
Lower labials*	6-5	5-6	5-5	5-5	6-7	6-6	6-7	6-6	5-5	5-6	6-6	6-6	6-6	5-5	6-7
Ventrals, transverse	32	32	28	[illegible]	29	29	30	31	34	30	33	29	30	29	33
Ventrals, longitudinal†	54	54	54	51	55	55	59	57	59	58	57	59	56	59	59

* Labials counted to a point below middle of eye. † Counted from anterior margin of insertion of foreleg.

weakly keeled, and those on the tail, if distinguishable, are scarcely so, and are smooth.

The postanal pores are present in both males and females, although larger and more conspicuous in males. Cloacal bones are present only in males. Sexes may easily be distinguished by probing the flesh in front of the postanal pores, determining the presence or absence of the cloacal bones. The oblique row of slightly enlarged scales immediately behind the insertion of the hindleg are present in both males and females, although slightly more enlarged in the former.

There seems to be no marked sexual dimorphism in color. The color pattern is practically identical in all specimens.

Comparisons. Comparisons of this species with *P. tuberculosus* and *P. lanei* are given in the discussion under the latter species.

Habits and Habitat. The specimens were secured in arid or semiarid regions, and were taken at night in shrubs, on the ground between rocks or on the rocks themselves.

Some of the females contained well-developed eggs in the oviducts.

Distribution. It seems likely that at least a portion of the numerous records of *P. tuberculosus* from Baja California, and those from the southern part of California, are based upon specimens of the species described above. Mr. Klauber has kindly loaned material for comparison from these localities, at least part of which seems to be identical with the specimens from Sonora. The specimens of *P. tuberculosus* recorded by Allen (1933) from Sonora and Cope (1900) from Chihuahua are probably *P. homolepidurus.*

Phyllodactylus lanei sp. n.

(Text fig. 1B; Plate XXV, fig. 3)

Type. EHT and HMS No. 1461, male, collected near Tierra Colorada, Guerrero, Mexico, June 30, 1932, by Edward H. Taylor and Hobart M. Smith.

Paratypes. Twenty-nine, nine of which were collected with the type (EHT and HMS Nos. 1458, 1459, 1462, 1516-1520, 1522); three from a locality 44 miles south of Chilpancingo (2 miles south of Gavapata), Guerrero, June 27, 1932 (EHT and HMS Nos. 1181-1183); ten from a locality about 1 mile north of Organos (south of El Treinte), Guerrero, June 28, 1932 (EHT and HMS Nos. 1339-1346, 1419, 1420); four taken between Rincon and Cajones (south of

Chilpancingo), Guerrero, July 7, 1932 (EHT and HMS Nos. 1499-1502); and three from Mazatlán, Sinaloa (EHT Nos. 534, 535, July 21, 1934; No. 741, July 24, 1934).

NOTE.—EHT and HMS Nos. 1180, 1338, 1460 and 1521 were presented to the Instituto de Biologia of the Universidad Nacional of Mexico. Although not examined in this study, it is almost certain that these specimens are of the same species as the above. No other species of geckos were collected in Guerrero.

Diagnosis. A Phyllodactylus attaining a maximum snout to vent length of 90 mm. to 95 mm.; occipital scales usually the largest of those on upper surface of head, much larger than the granules on body; interorbital scales usually of approximately the same size as the median scales in the frontonasal region; no row of enlarged scales following postmentals; scales of body (except tubercles) almost granular, the laterals very distinctly and abruptly differentiated from the ventrals; tubercles on body very large, trihedral, ovate, strongly keeled; conical tubercles present on upper surfaces of both fore and hindlimbs and on occiput; four rows of tubercles on each side at base of tail, three continued over most of the distal portion of tail; caudal tubercles keeled; scales granular on posterior surface of femur and dorsal surface of tibia (a few enlarged, scattered tubercles on tibia); cloacal bones of males flat throughout, the median termination not in the form of a bilobed spheroid whose median axis is at right angles to the plane of the remainder of the bone; tail with indistinct bands of darker gray; two rows of rounded, grayish spots extending the length of the body from occiput to base of tail; these spots sometimes widened laterally, but not giving the impression of crossbars; lower surfaces of tail and limbs heavily stippled with black.

Description of Type. Head flattened; dorsal profile (lateral view) of head a straight line from orbit to snout, the orbits slightly projecting, the occipital region almost parallel to axis of body; snout rounded; sides of head (dorsal view) almost straight to about halfway between orbit and nostril, curving to a rounded point at snout; jaws slightly constricted at level of orbits; a deep median frontonasal groove; lores slightly concave, at an angle of about 55° with the horizontal; interorbital scales in about seven rows, slightly smaller than scales between orbit and naris, about equal in size to the median scales in frontonasal region; occipital granules larger than others on dorsum of head and much larger than granules on body; numerous small, conical tubercles scattered over occipital and temporal regions, those in the temporal region considerably larger; twelve or thirteen upper labials, six to a point below middle of eye; nine lower labials, five or six to below middle of eye; rostral about twice as broad as long, rectangular, partially split in the posterior median line, its posterolateral corners in contact with nares; two internasals, in contact medially, somewhat broader than long; mental large, definitely triangular, its labial border about one-third greater than that of rostral; mental followed by two large, oval postmentals; these in contact with each other medially and with the first labial laterally; postmentals followed by four smaller scales in a row between labials; these followed by scales which gradually merge with the gulars; gulars small, merging with the abdominals in the cervical region; granules on body smooth, flat or slightly rounded; about eight longitudinal rows of enlarged tubercles on each side of back, the two median rows very distinct and straight, the six lateral rows more or less indistinct; tubercles of median rows oval, strongly keeled, trihedral, but those of lateral rows becoming round and conical; scales on upper foreleg rather heterogeneous, mostly keeled and elevated as are the tubercles on the body, with smaller, smooth scales interspersed between; scales on anterior aspect of upper foreleg about as large as those on belly, mostly smooth, but becoming keeled toward dorsum; ventral scales of upper foreleg granular; ventral scales of lower foreleg larger, but slightly smaller than ventral abdominals; dorsal scales of same member small, of about the same size as those on back, with scattered, keeled tubercles; lamellar formula for fingers (to bases and excluding terminal lamella): 7-10-11-14-10; at least the distal lamella, in all cases, divided; scales on ventral and anterior surfaces of femur squamous, the former smaller than the latter and of approximately the same size as abdominals; scales on upper surface of femur small, with a few large, weakly keeled or conical, oval or rounded tubercles; posterior femoral surface with granular scales; dorsal surface of foot with small scales and a few enlarged, weakly keeled, rounded tubercles; lamellar formula for toes: 7-10-15-14-12; at least the distal lamella, in all cases, divided; scales in axilla and groin, above insertion of foreleg and behind and above insertion of hindleg, very small or granular; cloacal wall produced backward about two millimeters, broadly U-shaped; on each side of this protuberance of the cloacal wall, near the anus, is a narrow, transverse pore opening into a sac below the cloacal bone, but not connected with the hemipenis; three or four slightly enlarged scales in an oblique row immediately behind insertion of hindleg and near anus; eight dorsal rows of enlarged, weakly keeled tubercles continued onto base of tail, decreasing to six rows at the third whorl; six are present in the remaining whorls of the tail (about two thirds regenerated and with abnormal scalation); whorls of enlarged tubercles separated by four or five rows of small, smooth scales; a series of large transverse subcaudals, irregularly broken immediately behind anus.

Color above grayish; a darker band from snout to orbit and from orbit through upper part of ear to upper margin of insertion of foreleg; labial region dimly barred; a few irregular, indistinct dark spots on head; two series of darker spots near median dorsal line, passing from occiput to base of tail, about eleven in each series; forelegs dimly banded with darker; ventral surface of tail closely stippled with black; ventral surface of limbs stippled slightly with black, belly and gular region almost immaculate.

The cloacal bones are in this species flattened throughout; the lateral part of the bone is in the same plane as the body, but the bone gradually twists until, at the median tip, it may be at right angles to the plane of the body. It curves about the postanal pore of the corresponding side.

Variation. In characters not subject to sexual dimorphism, there is but little variation shown, from the above description, in the paratype series. The mental is frequently pentagonal. The postmentals are constant, but the scales behind the postmentals are quite irregular. Three rows of enlarged tubercles extend down each side of the tail to about the fifth to the seventh whorl; two rows continue to the twelfth or thirteenth. Only in a few specimens are there four rows at the base of the tail. The oblique row of slightly enlarged scales immediately behind the insertion of the hindleg and near the cloacal opening are present in both males and females, although slightly more enlarged in the former. The two postanal pores are of about the same character in both sexes. The enlarged tubercles on the sides of the body are not regularly conical, but frequently are trihedral, as those near the middorsal line.

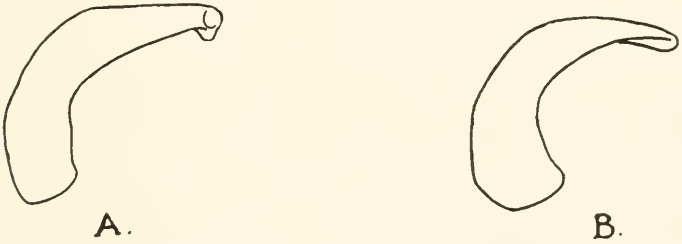
The interorbital and occipital scales are usually as in the type. However, in the three specimens from Mazatlán, and in six large specimens from Guerrero (Nos. 1181-1183, 1499-1501), the interorbital scales are small and the occipital and temporal scales granular. In a young specimen (No. 1500) collected at the same locality as Nos. 1499-1501, these scales are as in the type. The variation is not sexual. It is of interest that no such variation in the relative size of these scales occurs in the series of *P. homolepidurus.*

The dorsal spots are in some specimens partially fused, forming broken stripes down the back. In others the spots are produced transversely, but no appearance of bars is evident in any. The median dorsal line is immaculate in all.

The cloacal wall is produced posteriorly in the majority of the males (but not in all), and is never so produced in females. The cloacal bones are present only in males. There seems to be no marked sexual dimorphism in color.

Habitat. The majority of the specimens were secured under loose slabs of rock during the day, or far back in the darker recesses of the larger cracks between boulders, etc. Others were found under loose bark on trunks of trees, or deep in the rotten hearts of large standing trees. At night numbers were secured running about on the bare faces of boulders or cliffs, their gray, ghost-like forms scarcely visible.

Comparisons. From *P. homolepidurus* this species differs in a number of very obvious characters. In the former the occipital and interorbital scales are always small and subequal in size to the granular scales on the body, and much smaller than (about one fourth as large as) the median scales in the frontonasal region. In *P. lanei* they are usually much larger, as described above. The granules on the body are smaller in *P. lanei,* the laterals distinctly differentiated from the ventrals. They are larger in *P. homolepidurus* and less distinctly differentiated from the ventrals. In *P. homolepidurus* the enlarged tubercles are smaller, weakly keeled, and absent or very indistinct on the upper parts of the fore and hind legs; the tubercles of the tail are in this species very small, smooth, and not over two in a whorl, when present. The cloacal bones of *P. homolepidurus* are, at the median end, modified to form



TEXT FIGURE 1. Cloacal bone of right side, ventral view. A. *Phyllodactylus homolepidurus.* B. *Phyllodactylus lanei.*

a bilobed spheroid protuberance which is at right angles to the axis (longitudinal) of the body. The cloacal wall is apparently only very slightly produced posteriorly in males of *P. homolepidurus*, but is frequently so produced in *P. lanei*. The maximum size of the latter species far exceeds that of the former (91.5 mm. and 67.5 mm., snout to vent, respectively). *P. homolepidurus* is distinctly lighter in color, both ventrally and dorsally, and the blotches on the back tend to form broken transverse bars. Finally, the habitat of the two forms is quite different. *P. homolepidurus* is known only from arid or semiarid regions, while *P. lanei* apparently is confined to tropical regions with more or less dense vegetation.

The original description and figure of *P. tuberculosus* differs in a number of important respects from the species here described. Perhaps the most important is the shape of the terminal lamellae of the digits, which in the above figure are shown to be rounded, not truncate at the tip as in *P. lanei* and *P. homolepidurus*, and Wiegmann states that "Alle Zehen unter der Spitze mit zwei grossen verkehrt-eyförmigen, dunnen, blattartigen, ganz glatten schuppen versehen. . . ."

Secondly, in *P. tuberculosus* the enlarged tubercles on the tail are "in undeutliche Quergurtel gestellt; an reproducirten Schwanzen erscheinen sie sehr ungleich, dicht anliegend, glatt und geschindelt." Further, the mental is "jederseits von einem vieleckigen Schildchen begrenzt, hinter dem in der Quere 4-5 kleinere Schildchen liegen." Only the first-mentioned shield exists in *P. lanei* and *P. homolepidurus*.

The accuracy of reproduction in Wiegmann's figure is not assured, but in it the enlarged tubercles of the body, and especially in the temporal region, are larger even than in *P. lanei,* in which species these tubercles are in turn much larger than in Californian specimens of Phyllodactylus and in *P. homolepidurus*. Moreover, the scales of the posterior surface of the femur and the dorsal surface of the tibia are shown to be quite large and not granular; they are granular, with larger scattered tubercles on the tibia, in both *P. lanei* and *P. homolepidurus*. The scales on the ventral surface of the metatarsal region are quite small and abruptly differentiated from the larger scales of the tibia in the latter two species—not as shown in the figure of *P. tuberculosus*. Finally, five upper labials are shown to a point below the middle of the eye; in neither *P. lanei* nor in *P. homolepidurus* are there less than six.

Apparently the only species of Phyllodactylus recorded from

Measurements and scale counts of *Phyllodactylus lanei*

Number	741	584	1346	1339	1420	1459	1341	1458	1499	1517	1182	1500	1183	1181	1461	1501
Sex	♂	♀	♀	♂	♀	♀	♂	♂	♀	♂	♂	♀	♀	♂	♂	♂
Snout to vent	39.0	49.5	55.7	59.5	59.5	63.0	64.0	65.0	68.0	68.5	69.0	76.0	78.0	79.3	79.5	91.0
Snout to ear	10.5	12.0	14.5	15.1	15.0	15.9	16.6	16.0	17.0	17.0	17.0	18.0	18.0	20.0	20.0	21.5
Head width	8.9	10.0	11.0	12.5	11.0	12.5	13.2	12.9	13.8	14.9	14.7	15.0	15.5	16.0	16.0	17.5
Snout to orbit	4.9	6.0	7.1	7.8	7.1	7.8	8.0	8.0	8.0	7.8	8.8	9.0	9.0	10.0	9.8	10.0
Diameter of orbit	2.7	3.1	3.3	4.1	3.9	3.9	4.1	4.1	4.0	4.0	4.0	4.9	4.5	4.8	4.9	5.0
Foreleg	12.6	16.0	19.5	21.0	20.0	21.0	23.0	22.5	24.5	22.0	24.0	24.0	25.0	27.0	25.5	29.5
Hindleg	....	19.0	24.0	25.2	27.4	26.0	28.0	28.0	33.0	30.0	29.0	32.5	35.5	33.0	34.0	38.0
Fourth toe	4.5	5.5	6.5	7.5	6.8	7.5	8.1	7.8	8.7	8.6	9.0	9.0	9.5	9.3	9.0	10.8
Upper labials*	6-6	7-7	7-7	7-7	6-7	6-6	7-6	6-7	7-7	6-6	7-6	7-7	6-6	7-7	6-6	6-6
Lower labials*	5-5	6-6	6-6	7-6	5-5	5-5	5-5	6-5	6-6	5-4	5-5	6-6	5-5	6-6	5-6	5-5
Ventrals, transverse	37	31	29	30	29	31	29	27	24	31	27	25	29	29	24	24
Ventrals, longitudinal†	55	55	68	70	66	64	64	66	54	64	54	53	53	53	63	55

* Labials counted to a point below middle of eye. † Counted from anterior margin of insertion of foreleg.

Mexico, aside from the forms which have been considered under the name of *P. tuberculosus,* is *P. mentalis* Werner (1910). The latter author states that the locality from which the single type specimen came is doubtful, adding the remark: "Aus dem Nachlasse von L. v. Poppinghausen, also wahrscheinlich Zentralamerika, speziell Mexico." Burt and Burt (1933) state that the range is "Probably South America"—a logical supposition, as most of the American specimens described by Werner in this paper came from South America.

P. mentalis, however, belongs to the group of the genus with twelve longitudinal rows of tubercles on the back. Most of the other characters mentioned in the type description are not distinctive. Twelve lamellae under the fourth toe are said to be present in *P. mentalis;* fourteen are present in both *P. homolepidurus* and *P. lanei.*

Distribution. Records of *Phyllodactylus tuberculosus* from continental Mexico are from the following states: Chihuahua (Cope, 1900); Colima (Dugès, 1870, 1896); Durango (Baird, 1859; Boulenger, 1885; Cope, 1887; Günther, 1890; Van Denburgh, 1897); Guerrero (Günther, 1890; Dugès, 1896; Gadow, 1905); Jalisco (Dugès, 1870, 1896; Cope, 1887; Günther, 1890); Michoacán (Dugès, 1896); Nayarit (Mocquard, 1899); Oaxaca (Sumichrast, 1880; Cope, 1887; Günther, 1890; Gadow, 1905; Mertens, 1930); Puebla (Dugès, 1896); Sinaloa (Boulenger, 1885; Günther, 1890; Van Denburgh, 1897); Sonora (Allen, 1933). The records from Chihuahua (if correct) and Sonora very probably refer to *P. homolepidurus.* The record from Puebla seems doubtful. The others quite possibly refer to *P. lanei.*

Remarks. No. 585, measuring 24.5 mm. from snout to vent, was probably captured soon after hatching. None of the females contain eggs in the oviducts.

The species is named for Dr. H. H. Lane, who has forwarded in every possible way my work on Mexican herpetology.

Hemidactylus turcicus (Linné)

(Plate XXIII, fig. 2)

Two specimens (DHD and HMS Nos. 1515, 1516) were taken at Hacienda La Clementina, 12 miles east of Llera, southern Tamaulipas, Mexico, on August 9 and 10, 1934. One was found under machinery in an open-sided shed; the other was taken on the inside of a box in a deserted house.

The characters are essentially those assigned by Boulenger

(1885a). The first pair of postmentals are separated on the median line by a single scale about one third the size of either postmental. The accompanying table gives measurements and scale counts.

The only other species of Hemidactylus known in Mexico are *H. mabouia* (Moreau de Jonnès) and *H. exsul* Barbour and Cole. *H. mabouia* has been recorded only by Boulenger (1885a); he mentions specimens from Vera Cruz and "Mexico." It is noteworthy that Günther did not mention the species in Biologia Centrali-Americana.

NOTE.—*Hemidactylus navarri* Dugès (1883) was later (1896) referred by the same author to the synonymy of *Gehyra mutilata.*

Stuart (1934) states that *H. exsul,* described from Yucatan, is a synonym of *H. turcicus.*

Measurements and scale counts of *Hemidactylus turcicus*

Number	1515	1516
Snout to vent	25.0	31.5
Tail	....	31.0
Snout to ear	7.0	8.0
Width of head	5.5	7.0
Foreleg	8.0	10.0
Hindleg	9.0	13.0
Preanal pores	5	6
Ventral lamellae, first toe	6–6	6–6
Ventral lamellae, third toe	8–8	9–8
Ventral lamellae, fourth toe	9–9	10–10
Ventral lamellae, first finger	6–6	6–6
Ventral lamellae, third finger	7–7	7–7
Ventral lamellae, fourth finger	8–8	8–8
Upper labials	7–8	7–8
Lower labials	7–7	8–8
Ventral scales, longitudinal count	42	49

Iguana rhinolopha Wiegmann

Six specimens are in the collections: Vera Cruz, near Tierra Colorada, July 15-17, 1932 (EHT and HMS Nos. 2043, 2199). Sinaloa, Presidio, near Mazatlán, July 2, 1934 (EHT Nos. 650-653).

The large scales in the dorsal crest vary from 51 to 58 in number from the occiput to the base of the tail. In the youngest specimen

(84.5 mm. from snout to vent) the median scales on the snout are distinctly tubercular, although not so strongly as in the larger specimens.

The species has been previously reported from the following states: Chiapas (Boulenger, 1885b); Colima (Cope, 1887; Dugès, 1870, 1896; Gadow, 1905); Jalisco (Van Denburgh, 1897); Michoacán (Dugès, 1896); Morelos? (Gadow, 1905; Totolapan); Oaxaca (Sumichrast, 1880; Günther, 1885; Cope, 1887); Puebla (Ferrari-Perez, 1886; Cope, 1887); Sinaloa (Boulenger, 1885b; Günther, 1885; Van Denburgh, 1897); Tabasco (Cope, 1887); Vera Cruz (Boulenger, 1885b; Günther, 1885; Ferrari-Perez, 1886; Cope, 1887; Gadow, 1905). It is also known from Cozumel Island (Boulenger, 1885b; Cope, 1885; Günther, 1885; Cope, 1887).

Ctenosaura pectinata (Wiegmann)

Ctenosaura brachylopha Bailey, 1928.
Ctenosaura teres brachylopha Cope, 1886.

Fifteen specimens are in the collections, from the following localities: Guerrero, near Puerto Amitzingo, southwest of Puente de Ixtla, June 22, 1932 (EHT and HMS Nos. 677, 774); near Junction of Acapulco-Mexico highway and Rio Balsas, June 23, 1932 (EHT and HMS No. 842); 1 mile north of Organos, south of El Treinte, June 28, 1932 (EHT and HMS No. 1297); near Tierra Colorada (EHT and HMS No. 1539, June 30, 1932; No. 1657, July 4, 1932); 16 miles south of Tierra Colorada, July 4, 1932 (EHT and HMS No. 1441). Nayarit, near Tepic, July 31, 1934 (EHT No. 936). Sinaloa, 10 miles south of Presidio, near Mazatlán, July 19, 1934 (EHT Nos. 525-527); near Mazatlán, July 20, 1934 (EHT No. 583); near Presidio, near Mazatlán, July 21, 1934 (EHT Nos. 654-656).

Bailey (1928) distinguishes *C. pectinata* from *C. brachylopha* by the continuation in the former of the enlarged scales of the dorsal crest over the sacral region. He restricts the range of the latter to the states of Sinaloa and Nayarit, and that of *C. pectinata* largely to the coastal region, in the states of Nayarit, Colima, Guerrero and Oaxaca.

The detailed study made of our specimens has failed to reveal any constant differences in color, proportions or scalation which would characterize the two forms. Although it is true that in most of the specimens within the range of *C. brachylopha* (as stated by Bailey), the sacral crest cannot be distinguished, and that most of the specimens from southern localities possess low sacral crests, yet sporadically throughout the whole territory covered by our collections there occur specimens which show either extreme in the character of the sacral crest, or are intermediate. It would seem obvious that such a distinction, especially since it forms the only basis proposed for the separation of the two species, is at best very delicate and quite likely to vary.

In No. 774, from Guerrero, the scales of the sacral crest are enlarged so slightly that they can scarcely be distinguished from the adjoining scales. In another (No. 677) from the same locality, the enlarged scales of the sacral crest are placed at intervals, with several granular scales occupying each of the spaces. The series of enlarged scales of the sacral crest is present in a specimen from Mazatlán (No. 656), but is broken medially by three small, undifferentiated scales. Another specimen from Guerrero (No. 1539) lacks the sacral crest entirely, while the one from Tepic (No. 936) possesses a distinct, complete crest.

Dr. J. W. Bailey has kindly examined two of the above specimens (Nos. 774 and 1539), and has stated that he considers them as belonging to *C. brachylopha*, "even though found outside of the known bounds of distribution."

Unassociated as these variations are with other characters which might serve to distinguish the species, it seems quite unwise to attempt to recognize two forms. It is not unusual in reptiles to find that there are general tendencies in a species for some character to vary in frequency of occurrence from one extreme at one limit of its range to the other extreme at the other limit of its range, with occasional scattered occurrences of either extreme or intermediates at any point in the entire range. Many such variations are pointed out by Ruthven (1908) for different characters in various species of Thamnophis; so also by Blanchard (1921) in Lampropeltis, by Ortenburger (1928) in Masticophis and Coluber, and by Burt (1931) in Cnemidophorus. It seems logical to so interpret the presence or absence of visibly enlarged scales in the median sacral region—a character varying geographically and of apparently no pertinent significance as a specific or subspecific character, unaccompanied by any other discernible differences.

The arrangement of the scales intercalated between the whorls of enlarged caudals varies but little. The number is slightly more reduced in several specimens from Sinaloa than it is in the southern specimens. Contrary to Bailey's (1928) statement that a single intercalated series is present between the whorls on the distal end of the tail, there exist, in all our specimens, two. Three intercalated

Measurements and scale counts of *Ctenosaura pectinata*

Number	583	774	1441	677	656	1297	655	1539	527	1657	842	525	654	526
Sex	yg	yg	yg	♀	♂	♀	♂	♀	♂	♀	♀	♂	♀	♀
Snout to vent	47.0	59.0	61.0	112.0	130.0	134.0	157.0	157.0	157.0	169.0	172.0	200.0	232.0	235.0
Tail	122.5	157.0	155.0	285.0	283.0	323.0	293.0	384.0	319.0	413.0	391.0	225.0	336.0	....
Snout to ear	13.0	15.0	15.0	24.0	28.0	28.0	34.0	33.0	33.5	32.5	34.0	43.0	47.0	46.0
Width of head	8.5	10.2	9.0	13.5	17.0	17.0	17.5	20.0	18.0	22.0	20.0	21.0	29.0	26.0
Hindleg	42.0	47.0	49.5	81.0	89.0	100.0	98.0	113.0	104.0	115.0	114.0	126.0	136.0	132.5
Femoral pores	7–8	7–7	6–6	5–5	7–8	5–7	7–9	5–6	7–8	4–4	6–6	6–7	8–8	6–6
Fourth toe from base of fifth	19.0	23.0	23.0	34.0	36.0	42.0	41.0	48.0	42.5	48.0	48.0	50.0	52.0	48.0
Fifth toe	7.0	8.0	8.0	13.0	14.5	17.0	19.0	19.5	18.3	20.0	20.0	22.0	22.0	21.5
Fourth finger from base of fifth	8.8	9.5	10.0	15.0	16.0	19.0	19.0	21.7	19.5	21.0	22.0	24.0	26.0	23.0
Ratio, hind leg to snout-vent	.893	.796	.811	.723	.684	.746	.624	.719	.662	.680	.662	.630	.586	.563
Scales about fifth verticil	40	40	41	36	35	42	37	39	37	43	39	41	36	41
Median dorsals to anterior border of thigh	68	57	65	60	68	65	64	64	64	67	69	71	68	64
Lamellae, first toe	11–11	12–14	11–11	14–13	12–12	13–13	13–12	11–11	11–12	13–13	13–?	13–12	12–11	12–10
Lamellae, second toe	17–19	19–20	18–18	19–20	18–19	20–21	17–19	19–19	18–18	20–21	22–21	18–19	18–17	19–17
Lamellae, third toe	22–?	28–25	25–26	28–29	23–24	27–26	25–24	26–27	26–25	28–29	30–31	24–26	23–24	22–22
Lamellae, fourth toe	34–38	40–38	36–37	41–41	34–33	38–38	35–34	39–40	36–36	42–41	43–43	38–36	36–37	33–35
Lamellae, fifth toe	22–20	24–23	22–22	25–23	20–21	24–24	22–22	21–21	21–22	26–25	25–25	22–23	21–19	20–21

series, either complete or incomplete, are present to between the tenth and eleventh whorls (maximum), three complete series are present to between the seventh and eighth whorls (maximum). Two series are present between the whorls on the remainder of the tail. In four specimens from Sinaloa there are at no place on the tail three complete rows preceding the whorls; in one (No. 526) the third row (of the series between the first and second whorls) is incomplete by two scales on one side; in another (No. 525) the third row is incomplete by two scales on each side; in Nos. 654 and 656 there are two complete rows and a short row on each side intercalated both dorsally and laterally.

The young are blue-green in color, as in the case of other species of Ctenosaura. With an increase of size to about 110 mm. (snout to vent), the dorsal pattern is of a rather uniform reticulation of black on blue; the ventral surfaces are light blue and the gular region is faintly spotted with darker. In slightly larger specimens (about 135 mm.), definite but dim transverse, dorsal bands are evident, about seven in number. These extend onto the belly and appear as transverse rows of circular, black spots. The gular region is more strongly maculate and the lower labial region is barred. Adults are rusty brown above, darker posteriorly, with but very faint traces of dorsal bands. One or more bands transverse the belly anteriorly. The tails of immature specimens are banded alternately with black and light blue. These bands become alternately dark and light brown in the adults, more distinct distally.

Bailey (1928) records the species from the states of Sinaloa, Colima, Nayarit, Guerrero, Oaxaca and Puebla. Dugès (1870, 1896) records it also from the states of Jalisco and Morelos.

Ctenosaura acanthura (Shaw)

Seventeen specimens are in the collections, from the following localities: San Luis Potosí, 5 miles south of Valles, June 13, 1932 (EHT and HMS No. 532). Vera Cruz, near Tierra Colorada, July 16, 1932 (EHT and HMS No. 2429); Tamaulipas, Hacienda La Clementina, 3½ miles west of Forlón, August 4-10, 1934 (DHD and HMS Nos. 1266, 1431-1434, 1566-1574).

The dorsal crest is in several specimens continuous across the sacral region, although the scales of the crest are very low.

Bailey (1928) states that the number of scales intercalated between the whorls of enlarged scales is reduced to one on the distal end of the tail. This is not the case in our specimens. The number is reduced to one complete row, or one complete and another incomplete, between some of the whorls from the fifth to about the fourteenth. The remainder of the whorls on the distal part of the tail are separated by two rows of scales. Bailey (1928) further states that the first and second or the first, second and third whorls are separated by three rows of small scales. In several specimens of our series, the first and second whorls are separated by two complete and another incomplete rows of scales; in about an equal number they are separated by three complete rows.

The scales of the dorsal crest are all black and slightly compressed laterally. They decrease gradually in size posteriorly in males.

C. acanthura, as well as the possibly related *C. similis*, differs from *P. pectinata* in the smaller lamellar formulae, as can be seen by comparisons of the tables of measurements and scale counts.

The young, as in other species of Ctenosaura, are blue-green in color. In specimens about 150 mm. from snout to vent, the green is most evident laterally. Black bars are visible on the middorsal line, much as in *C. pectinata*, and these continue onto the sides of the belly. They become narrow on the sides of the body, are preceded

Measurements and scale counts of *Ctenosaura acanthura*

Number	1266	1433	1462	1432	1431	1434	532
Sex	♀	♂	♀	♀	♀	♀	♀
Snout to vent	159.0	227.0	228.0	233.0	233.0	239.0	260.0
Tail	332.0	351+	....	....	....	....	447.0
Snout to ear	32.5	52.5	44.0	45.0	43.0	47.0	55.0
Width of head	19.0	29.5	28.0	28.0	25.0	28.0	31.0
Hindleg	106.0	140.0	127.0	135.0	133.0	137.0	156.0
Femoral pores	7–7	7–8	5–6	6–6	6–7	6–7	6–7
Fourth toe from base of fifth	46.0	60.0	55.0	54.0	55.0	55.0	60.0
Fifth toe	20.0	25.0	22.0	24.0	23.0	24.0	26.0
Fourth finger from base of fifth	21.0	27.0	25.0	26.0	16.5	27.0	30.0
Ratio, hindleg to snout-vent length	.666	.616	.557	.579	.570	.573	.600
Scales around fifth verticil	42	42	38	38	38	41	36
Median dorsals to anterior border of hindleg,	71	72	71	68	70	71	74
Lamellae, first toe	12–12	14–13	13–13	15–13	14–13	12–12	11–12
Lamellae, second toe	19–19	21–21	21–19	21–22	20–19	20–20	18–19
Lamellae, third toe	25–24	25–26	25–23	24–25	26–25	24–24	21–24
Lamellae, fourth toe	36–34	35–36	37–33	36–38	37–38	37–34	35–34
Lamellae, fifth toe	25–24	24–24	24–22	24–24	25–24	24–23	22–21

by narrow bands of whitish, and are followed by broad areas of green, appearing in this respect much like Iguana. As larger size is reached, the whole dorsum becomes uniform black in both males and females, and the venter is suffused to varying degrees with the same color.

Bailey (1928) reports this species from the states of Chihuahua, Guerrero, Michoacán, Morelos, Nayarit, Oaxaca, Sinaloa, Tamaulipas and Vera Cruz. There are also records from the states of Colima (Cope, 1887; Günther, 1890), Durango (Boulenger, 1885b; Günther, 1890), Jalisco (Dugès, 1896), Mexico (Boulenger, 1885b; Günther, 1890), Puebla (Cope, 1885; Ferrari-Perez, 1886; Gadow, 1905), and Yucatán (Cope, 1886; Günther, 1890; Ives, 1891). It is very probable that the records from Yucatán are erroneous, and possibly also those from Puebla.

Ctenosaura similis (Gray)

Five specimens were secured on July 17, 1932, near Tierra Colorada, Vera Cruz (EHT and HMS Nos. 2045-7, 2127, 2128).

In coloration, character of the dorsal crest and arrangement of caudal scales this species differs markedly from an apparently related species, *C. acanthura,* whose range it overlaps.

The adults are rusty brown in color anteriorly, becoming largely black posteriorly. About eight dark crossbands are present on the back, the first three rather dim. The limbs are black above, with narrow bands of brown. The tail is but dimly banded.

The scales of the dorsal crest are longest on the nape in males, and decrease abruptly in size in the scapular region, somewhat as in *C. hemilopha.* The crest scales are not laterally compressed, and are white except where the dorsal black bands traverse them. In *C. acanthura* all of the crest scales are black, and there is no abrupt reduction in size in the scapular region.

The difference in the arrangement of the caudal scales is not so marked. In four of the five specimens of *C. similis* there is at no place on the tail a reduction to one row of the scales between the whorls. At least two complete series extend the full length of the tail. In these four, the first and second whorls are separated by three complete rows. In the exceptional specimen (No. 2046), however, the scales between the whorls are reduced to one row and part of another from between the seventh and eighth to between the twelfth and thirteenth whorls, the remaining whorls separated by two rows. The first and second whorls, also, are separated by two complete and one incomplete rows. The coloration and the character of the dorsal crest, however, compares well in this specimen with the same in the other specimens.*

The specimens were shot as they basked in the sun on top of the standing walls of a tumbled-down adobe house.

Bailey (1928) records the species in Mexico from the states of Yucatán, Chiapas, Tabasco and Oaxaca. Ruthven (1912a and b) records *C. acanthura completa* (a synonym of *similis, fide* Bailey), from various points in southern Vera Cruz.

Ctenosaura hemilopha (Cope)

(Plate XXIII, fig. 1)

The specimens were collected by Taylor in Sonora during the summer of 1934, one (EHT No. 235) 10 miles northwest of Guaymas, June 30, the other (EHT No. 121) 5 miles southwest of Hermosillo, June 26.

These specimens differ in a number of respects from the descriptions available of *C. hemilopha* from Baja California. This species is said to have "the first and second, and occasionally the third, of these whorls separated from each other by three series of smaller smooth scales; third, fourth, fifth, and sixth spiny whorls preceded by two series of smooth scales" (Bailey, 1928, largely quoting Van Denburgh, 1922). In our specimens the first and second whorls are separated by two rows of smaller scales, with a short series intercalated (in No. 235) on the median dorsal line. The second and third whorls are separated by two complete rows of smaller scales; the third and fourth whorls, by one complete series and another short series intercalated on either side of the single median dorsal scale; one row of small scales precede the fifth and remaining distal whorls.

Secondly, it is stated that in *C. hemilopha* the dorsal crest "is continued on the middle third of vertebral line of body as series of enlarged flat plates, but is not traceable on posterior third" (Bailey, 1928). This is not the case in our specimens. The crest disappears approximately at a point above the anterior margin of the insertion of the hindleg. Moreover, neither is the statement true for MCZ No. 13179, from San Pedro Island, which specimen is figured by Bailey (1928, pl. 5). In this plate the crest may be seen to continue posteriorly to a point a short distance anterior to the anterior margin of the insertion of the hindleg.

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* The table of measurements and scale counts has been inserted in the discussion under *Ctenosaura hemilopha.*

Descriptions also mention but five black blotches on the vertebral line, yet in the Sonoran specimens there are nine crossbars on the back, the anterior three of which are black; the remaining are seal-brown. Essentially the same color pattern as in the latter specimens, however, is possessed by the specimen figured by Bailey (*loc. cit.*). It is possible that the number of bars which appear black in color is a matter of age.

The lateral dark cervical bars, mentioned by Van Denburgh (1922), are very indistinct.

This rather marked variation from the descriptions of *C. hemilopha*, especially with regard to the arrangement of the caudal scales, suggests the possibility that the Sonoran form is distinct, at least subspecifically, from the form in Baja California. However, Bailey's photograph of *C. hemilopha* does not agree with his description of the species, nor with Van Denburgh's (1922), as has been pointed out above. It distinctly resembles our Sonoran specimens in coloration and in extent of the dorsal crest. If the specimen figured represents the form which exists in the lower end of the peninsula of Baja California, it is unlikely that the Sonoran form is distinct.

Measurements and scale counts of *Ctenosaura similis* and *C. hemilopha*

	similis					*hemilopha*	
Number	2046	2045	2128	2047	2127	121	235
Sex	♀	♀	♂	♀	♂	♀	♂
Snout to vent	156.0	184.0	186.5	201.0	205.0	188.0	194.0
Tail	326.0	361.0	403.0	....	....	....	....
Snout to ear	32.0	33.0	41.0	42.0	43.0	35.0	45.0
Width of head	19.0	20.0	22.5	23.0	23.0	21.0	23.0
Hindleg	102.0	120.0	130.0	124.0	129.0	105.5	126.0
Femoral pores	5–5	5–7	6–7	5–6	7–7	6–8	7–6
Fourth toe from base of fifth	42.5	49.0	54.0	51.0	54.0	40.0	49.0
Fifth toe	18.0	21.0	23.0	22.0	24.0	16.5	19.5
Fourth finger from base of fifth	19.0	22.0	25.0	25.0	26.5	20.0	23.0
Ratio, hindleg to snout-vent length	.653	.652	.696	.616	.629	.561	.649
Scales around fifth verticil	37	39	43	37	39	37	38
Median dorsals to anterior border of hindleg,	70	68?	74	74	76	....	....
Lamellae, first toe	12–11	13–13	15–14	14–13	14–13	10–11	11–11
Lamellae, second toe	18–18	20–20	21–19	22–21	21–20	16–17	17–17
Lamellae, third toe	25–23	23–25	26–25	25–26	26–25	23–24	22–23
Lamellae, fourth toe	34–33	37–?	37–36	35–36	36–38	33–35	35–34
Lamellae, fifth toe	22–22	22–22	25–23	24–24	24–25	20–20	20–20

If, however, the specimen is different from the form occurring in southern Baja California, it would seem very probable that it represents a distinct form which also occurs in Sonora. Reëxamination of the material from these two states will be necessary to determine its exact identity.

There can certainly be no doubts longer entertained that *C. hemilopha* occurs in Sonora, although perhaps as a subspecies distinct from that of Baja California. Bailey (1928) records specimens from Camoa and Guaymas, Sonora, and Nogales, Arizona, but states that the "three young specimens from Guaymas were in all probability reared in that vicinity, the original stock having been taken there by travelers from one of the islands of the Gulf of California or from the mainland of Lower California. The Arizona record is very doubtful." Doctor Taylor observed specimens at numerous localities to the northeast of Guaymas and Hermosillo, and from this fact it seems logical to assume that the species is well established there and widely spread, possibly extending even into southern Arizona, for conditions similar to those in which Taylor observed the species exist over the entire territory.

The two specimens were obtained on rock cliffs, in which type of habitat they were frequently observed. They were quite wary and would hide far back in the cracks at the first sight of danger.

Basiliscus vittatus Wiegmann

Eleven specimens are in the collections from the following localities: Guerrero: 1 mile north of Organos, south of El Treinte, June 28, 1932 (EHT and HMS Nos. 1298, 1364, 1442-1444). Vera Cruz: 4 miles east of Encero, July 17, 1932 (EHT and HMS No. 2129); Puente Nacional, July 14, 1932 (EHT and HMS No. 2201); Tierra Colorada, July 15-16, 1932 (EHT and HMS Nos. 2202, 2203, 2417, 2044).

There are three fully developed eggs in the oviducts of one female. The stomach contents of several specimens examined consisted entirely of insects, not of vegetable matter.

The species has been reported frequently in Mexico from many localities in the southern part. Records have been published from the following states: Mexico (Boulenger, 1885b; Günther, 1890); Vera Cruz (Sumichrast, 1882; Boulenger, 1885b; Cope, 1887; Günther, 1890; Dugès, 1896; Gadow, 1905; Ruthven, 1912 a and b); Yucatán (Cope, 1866, 1887; Barbour and Cole, 1906); Oaxaca (Sumichrast, 1880; Cope, 1887); Colima (Cope, 1887); Chiapas (Ferrari-Perez, 1886; Dugès, 1896); and Guerrero (Gadow, 1905).

Crotaphytus collaris collaris (Say)

(Plate XXIV, fig. 1)

Four specimens were collected in 1932, in the following localities: San Luis Potosí: 30 miles north of Matehuala, August 20 (EHT and HMS Nos. 4050, 4051). Durango: 6 miles northeast of Pedriceña, August 27 (EHT and HMS No. 4484). Coahuila: 4 miles west of Saltillo, August 23 (EHT and HMS No. 4305).

The two specimens from San Luis Potosí are strikingly different in color pattern from the other two and from specimens in the Kansas University Museum from the United States. The anterior black collar is broken on the neck in three places, and the posterior collar is broken on the median line. Following these there are five transverse black bars across the back and extending onto the sides in one specimen, and six in the other. They are broken in a number of places in the latter specimen, and are absent on the tail except for two indistinct bars on the base, but in the other specimen are complete and continue to the tip of the tail, brown in color except for a single black band at the base of the tail.

The specimen from Durango has a few rounded, black or dark spots arranged in irregular transverse series across the back.

There are two rows of interorbital scales in all specimens; the median supraorbitals are slightly enlarged, and the dorsal scales are not enlarged on the median line. Despite the peculiarities in coloration of the Matehuala specimens, they cannot be considered distinct from *C. collaris* on the basis of the two specimens available. As shown in the following table, there are no distinct proportional differences.

Measurements and scale counts of *Crotaphytus collaris collaris*

I Number	4050	4305	4484	4051
II Sex	♀	♀	♀	♀
III Snout to vent	80 0	81 8	85 3	88 0
IV Tail	174.5	169.0	185 8	175 0
V Total length	254.5	250 0	271.1	263.0
VI Width of head	20.0	21.0	21 0	22.0
VII Snout to ear	20.0	21.0	23.0	24.5
VIII Hindleg	78.0	77.0	76.6	87.0
IX Femoral pores	20-20	18-19	20-20	20-20
X Ratio, VIII to III	.975	.941	.891	.988
XI Ratio, IV to V	.685	.673	.681	.665

The species has been reported from the states of Coahuila (Yarrow, 1883; Garman, 1887; Burt, 1928); Nuevo León (Yarrow, 1883; Günther, 1890; Cope, 1900; Gadow, 1905); and Chihuahua (Yarrow, 1883; Cope, 1887, 1900; Günther, 1890; Burt, 1928). Allen (1932) places specimens of *Crotaphytus collaris* from Sonora in the subspecies *dickersonae*. If this subspecies is shown to be valid on the mainland, it is likely that the other records also of *C. collaris* and *C. baileyi* from Sonora (Baird, 1859; Yarrow, 1883; Günther, 1890; Cope, 1900; Van Denburgh, 1897, 1922) are in reality of *C. dickersonae*.

Crotaphytus wislizenii Baird and Girard

Three specimens were secured during the summer of 1934 in the state of Chihuahua, 15 miles south of Juarez, June 19 (DHD and HMS Nos. 85, 86) and 2 miles south of Moctezuma, July 20 (DHD and HMS No. 87).

The species has been recorded in Mexico from the states of Baja California (Schmidt, 1922), Sonora (Baird, 1859; Bocourt, 1874a; Yarrow, 1883; Günther, 1890; Cope, 1900; Gadow, 1905; Van Denburgh, 1922) and Chihuahua (Gadow, 1905).

Phrynosoma cornutum (Harlan)

Four typical specimens were secured during the summer of 1934: 5 miles north of Moctezuma, Chihuahua, June 19 (DHD and HMS Nos. 341, 342); 25 miles north of Bermejillo, Durango, June 27 (DHD and HMS No. 347).

Phrynosoma modestum Girard

Three typical specimens were collected during the summer of 1934: 25 miles north of Bermejillo, Durango, June 27 (DHD and HMS No. 335); and 3 miles west of La Colorada, Zacatecas, July 9 (DHD and HMS Nos. 818, 817).

The species has previously been reported no farther south than Pedriceña, Durango (Smith, 1935).

Ameiva undulata undulata (Wiegmann)

Thirty-two specimens are in the collections, from the following localities: Guerrero: 1 mile north of Organos (south of El Treinte), June 28, 1932 (EHT and HMS Nos. 1347, 1348); between Cajones and Acahuitzotla (south of Chilpancingo), July 2, 1932 (EHT and HMS Nos. 1554, 1555); between Rincón and Cajones, July 1, 1932 (EHT and HMS Nos. 1474-1476). San Luis Potosí: 5 miles south of Valles, June 12, 1932 (EHT and HMS Nos. 421-423, 542). Vera Cruz: near Tierra Colorada (west of the city of Vera Cruz), July

15-16, 1932 (EHT and HMS Nos. 2204-2209, 2422-2428). Tamaulipas: 7 miles west of Victoria, August 2, 1934 (DHD and HMS Nos. 1227-1229); Hacienda La Clementina, near Forlón, August 7-10, 1934 (DHD and HMS Nos. 1455, 1522, 1523, 1525, 1526).

In scalation the specimens agree well with Barbour and Noble's (1915) description; Ruthven (1912) has described color variations as shown in males and females.

The species has been reported from the states of Vera Cruz (Cope, 1862, 1885, 1887; Ferrari-Perez, 1886; Günther, 1890; Gadow, 1905; Ruthven, 1912 a and b); Oaxaca (Sumichrast, 1880; Cope, 1887; Günther, 1890; Gadow, 1905); Chiapas (Bocourt, 1874b; Dugès, 1896); Colima (Cope, 1887); Guerrero (Gadow, 1905); and Michoacán (Dugès, 1896).

Heloderma horridum (Wiegmann)

A single specimen (EHT and HMS No. 773) was collected at night eleven miles southwest of Puente de Ixtla, Guerrero, Mexico, on June 22, 1932. The habitat in which it was found was one of grass and deciduous trees, quite unlike the arid, barren habitat which *H. suspectum* as a rule occupies.

The small tubercles about the larger ones, said by Cope (1900), quoting Wiegmann, to be absent in *H. horridum,* but present in *H. suspectum,* are present in this specimen, although much smaller than in specimen of *H. suspectum* of approximately the same size. A character of great difference in the two species is the size of the ear opening. In the specimen of *H. horridum,* it is about 4.5 mm. broad and 3 mm. long, while in a specimen of *H. suspectum* of approximately the same size the ear opening is 8 mm. broad and 4.5 mm. long. In other specimens of *H. suspectum* it is proportionately large. The claws of *horridum* are about 10 mm. long, and of the *H. suspectum,* 6 mm. As Cope (1900, p. 480) has pointed out, the tail is much longer in proportion to the body length in *H. horridum* than it is in *H. suspectum.* The caudal annuli are much fewer in *H. suspectum* (45-50) than in the Mexican form (78).

The coloration of the specimen agrees well with previous descriptions.

Measurements and scale counts are as follows: snout to vent, 266 mm.; tail, 213 mm.; snout to anterior border of ear, 49 mm.; foreleg, 83 mm.; hindleg, 90 mm.; fourth toe from base of fifth, 28 mm.; third finger (longest) from base of fourth, 18.5 mm.; scales from gular fold to anus, 62; caudal annuli, 78; scales on top of head between corners of mouth, 21.

Surprisingly few locality records of this species are available. Gadow (1905) remarks that "In Guerrero and Oaxaca, Colima and Jalisco everybody speaks of the 'Escorpión' . . . Hundreds of times I have offered much money, even to be taken to its lair, but all in vain." It is known from the following states: Sinaloa (Bocourt, 1878; Boulenger, 1885b, 1891; Günther, 1885; Cope, 1887; Gadow, 1905), Oaxaca (Bocourt, 1878; Sumichrast, 1870, 1880; Boulenger, 1885b, 1891; Günther, 1885; Cope, 1887; Gadow, 1905), Guanajuato (Günther, 1885), Jalisco (Dugès, 1870, 1896), Michoacán (Dugès, 1896; Gadow, 1905) and Colima (Dugès, 1896).

Anclytropsis papillosus Cope

(Plate XXIV, figs. 2 and 3)

Two specimens (EHT and HMS Nos. 535, 539) of this apparently extremely rare species were secured by Doctor Taylor and myself about twenty miles south of Valles, San Luis Potosí, on June 13, 1932, in a region of dense brush. They were found burrowing in rotten logs near an ant nest. Apparently they were feeding upon termites or ants, which were numerous in the logs.

The specimens agree almost perfectly with Cope's (1900) description. The scale rows about the body are twenty-four anteriorly, eighteen near the tail. In one specimen the parietal is fused on one side with the small scale which usually separates the parietal from the postocular. In the other specimen the small third supralabials are absent. No. 539 is 156 mm. from snout to vent; the tail is regenerated; 4.5 mm. from tip of snout to the "*rictus oris.*" No. 535 is 90.3 mm. from snout to vent; tail, 30.3 mm.; tip of snout to the "*rictus oris,*" 3.5 mm.

Caudal chevrons, which Camp (1923) says are questionably present, were found in the specimen examined for this character (No. 539).

The species has been known previously only from Jalapa (type locality; two specimens) and Motzorongo (Gadow, 1905; one specimen), Vera Cruz. One of the specimens from Jalapa was apparently retained by the Geographical and Exploring Commission of the Republic of Mexico, and the specimen is now possibly lodged in the Museo Nacional in Mexico City. The whereabouts of the other specimen (mentioned by Cope, 1900) is problematical. The latter author states that no specimens are in the United States National Museum. Gadow's specimen is undoubtedly in the British Museum.

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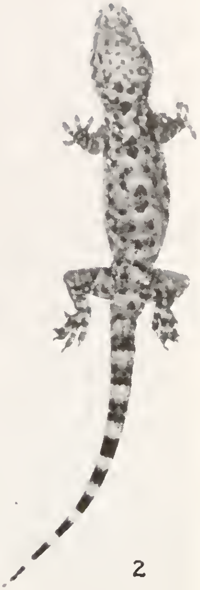
PLATE XXIII

FIG. 1. *Ctenosaura hemilopha.* Male, EHT No. 235. Snout to vent, 194.0 mm.

FIG. 2. *Hemidactylus turcicus.* Young. DHD and HMS No. 1516. Total length, 62.5 mm.

PLATE XXIII



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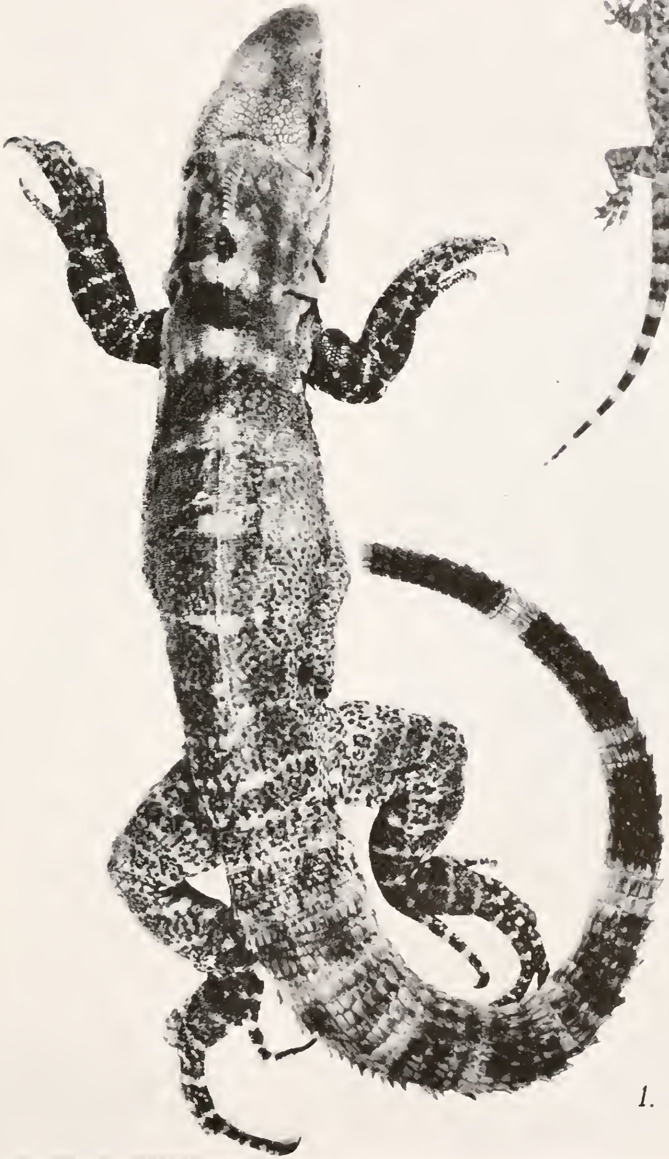


1.

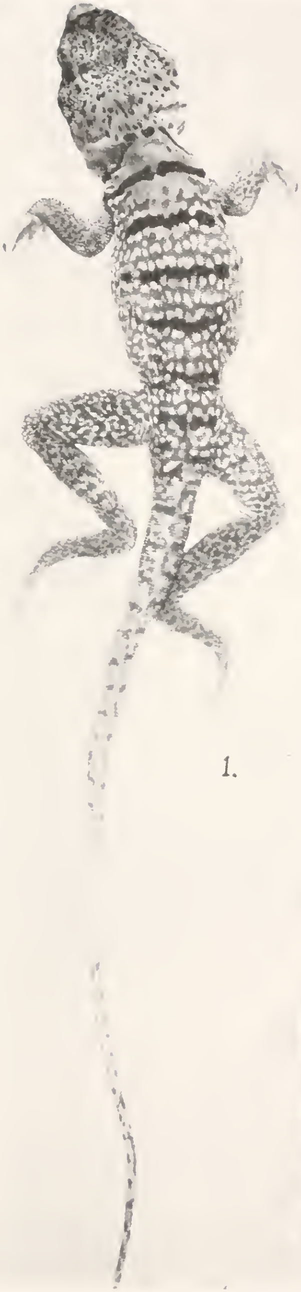
PLATE XXIV

FIG. 1. *Crotaphytus collaris collaris.* Female, EHT and HMS No. 4051:

FIG. 2. *Anelytropsis papillosus.* Side view of head. EHT and HMS No 535. × 10.5.

FIG. 3. Same, dorsal view of head.

PLATE XXIV



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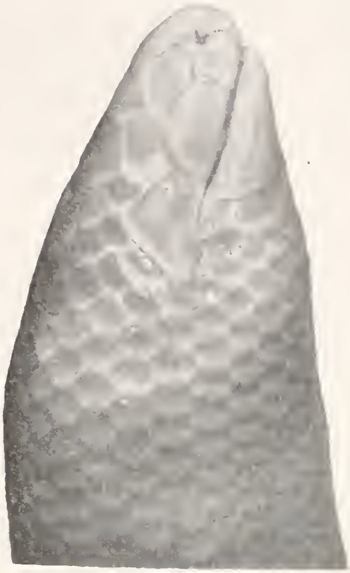

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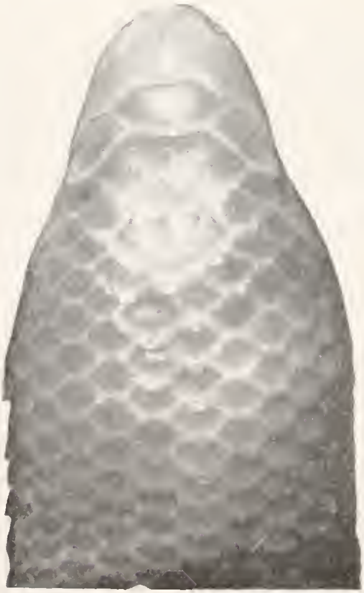


3.

PLATE XXV

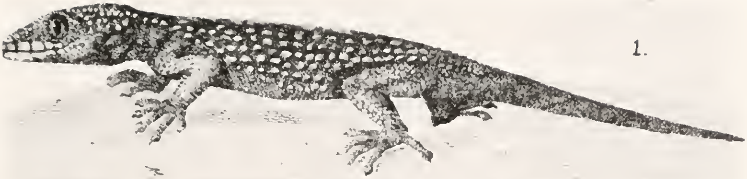
FIG. 1. *Phyllodactylus tuberculosus.* From Wiegmann, 1835. Original size.

FIG. 2. *Phyllodactylus homolepidurus.* Male, type.

FIG. 3. *Phyllodactylus lanei.* Male, type.

FIG. 4. *Phyllodactylus tuberculosus.* Ventral surface of foot. From Wiegmann, 1835. Original size.

PLATE XXV



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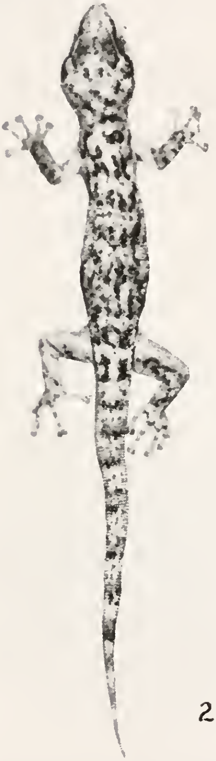

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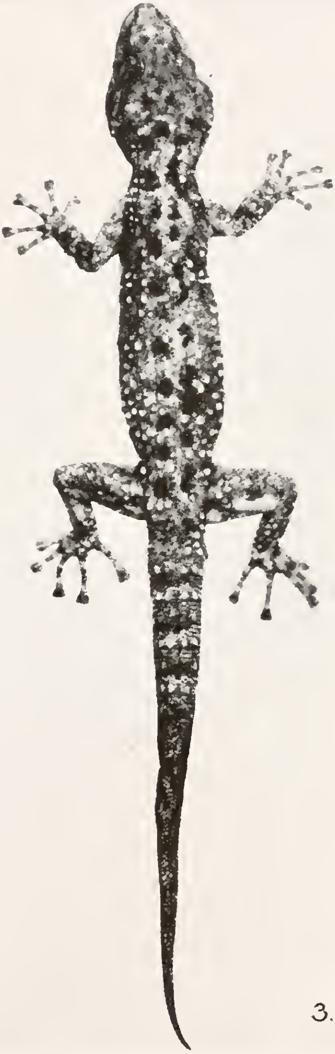

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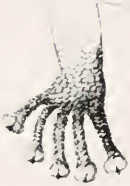

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Descriptions of New Species of Lizards from Mexico of the Genus Uta, with Notes on Other Mexican Species

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Abstract: The study is based upon Mexican specimens in the collections of Edward H. Taylor, David H. Dunkle and Hobart M. Smith. The species discussed are *Uta stansburiana stejnegeri, U. bicarinata, U. tuberculata, U. ornata ornata* and *N. ornata lateralis. Uta taylori* and *U. caerulea* are described as new.

THE following notes and descriptions are based upon specimens belonging to the genus Uta in three collections of reptiles and amphibians from Mexico—one secured during the summer of 1932 by Dr. Edward H. Taylor and myself, the others during the summer of 1934, one by David H. Dunkle and myself, the other by Taylor. Specimens in the first collection are designated by EHT and HMS; in the second by DHD and HMS; in the third by EHT.

I wish to here express my appreciation for the aid received, in the collection and study of this material, from Dr. Edward H. Taylor, Mr. David H. Dunkle, Mr. C. D. Bunker and Dr. H. H. Lane. I am indebted in particular to Doctor Taylor for the privilege of studying and describing a portion of his personal Mexican collection. Thanks are also due to Dr. G. K. Noble, who kindly compared a specimen of *Uta tuberculata* with the type; and to Mr. J. C. Bay of John Crerar Library for his kindness in loaning necessary reference books. The study has been aided by a grant from the University of Kansas graduate research fund.

Uta taylori sp. n.

(Plate XXVI, fig. 3)

Holotype. Male, EHT No. 320a, collected July 3, 1934, ten miles northwest of Guaymas, Sonora, Mexico.

Paratypes. Thirty-one, including twenty-four from the type locality (Nos. 252-258, June 30; 280-284, July 1; 300, 304, July 2; 320, 321, 322, 323a, on July 3; 335, July 4; 393, July 6; 474, 474a, July 12; 500, July 13); four (Nos. 199-202) from a locality 54 miles southwest of Hermosillo, Sonora, June 26; three (Nos. 448-450) from a locality 12 miles northwest of Guaymas, July 10. All were collected during the summer of 1934 by Dr. Edward H. Taylor and are in his personal collection.

Diagnosis. A Uta of the *U. stansburiana* group; dorsal scales average about 106 from interparietal to base of tail; enlarged dorsals abruptly differentiated from granular laterals only on posterior fourth of body; ratio of length of fourth toe to distance from snout to gular fold averages .786 in males, .771 in females; a distinct dermal pocket behind the insertion of the hind leg; no lateral light lines present on neck or sides of body in either young or adults; dorsal and lateral surfaces of body with numerous light flecks; dorsolateral series of blotches very dim when visible.

Description of Type. Head flattened; snout pointed; interparietal more than twice as large as ear opening; frontoparietals in contact in front of interparietal, separating latter from frontal; three parietals on each side; frontal entire; five transversely enlarged supraoculars, the median larger than the others; a series of from one to three rows of small scales intercalated between supraoculars and superciliaries; a row of small scales surrounding inner margin of orbit; five superciliaries; three canthals, the posterior large and overlapping anterior superciliary; three small postnasals, one subnasal, one prenasal and one supranasal; two pairs of internasals, the anterior pair quite small; scales between internasals and frontal large; rostral about as wide as distance between the centers of the nares; section of rostral on top of snout truncate behind, lateral edges in contact with labials, also truncate; four scales between posterior canthal and labials; four upper and seven lower labials to a point below middle of eye; mental pentagonal; a pair of large postmentals, in contact medially; these in contact also with mentals and lower labials, and followed by a series of enlarged scales passing to the angles of the jaws, and decreasing in size posteriorly; this series of enlarged scales separated from the labials anteriorly by one row of scales, posteriorly by three; median gular scales somewhat smaller than others; scales bordering gular fold larger than ventrals; temporals granular, except for three large scales in front of the ear and separated from the latter by about three rows of granules; three elongate scales on anterior border of ear, the upper largest and extending nearly halfway across ear opening; a dermal fold from ear to upper edge of lateral cervical pouch, thence to the upper edge of the gular fold, and above the insertion of the foreleg along the sides of the body to the groin; lateral cervical pouch small, low, more ventral than lateral in position; scales on body rounded, not mucronate; scales on nape granular, those on anterior half of nape not keeled, but with a single posterior dorsal projection; extreme laterals smooth, gradually becoming larger and keeled dorsally; laterals strongly differentiated from the dorsals only on posterior fourth of body; about eighteen rows of enlarged dorsals in a line between the centers of insertion of the hindlegs; dorsal rows of scales strongly converging posteriorly; dorsals on foreleg slightly larger than dorsals on body, rounded, and keeled except on hand; ventrals on upper foreleg granular, those on lower foreleg about as large as dorsals of the same member, smooth; lamellar formula for fingers 9-14-18-18-13; scales on anterior surface and anterior half of dorsal surface of femur about twice as large as largest dorsals on body, smooth on femur except in median dorsal region; ventral scales of femur somewhat smaller than ventral abdominals, smooth; dorsal scales on tibia somewhat smaller than those on anterior surface of femur, keeled, some mucronate; ventral tibial scales somewhat larger than dorsals on tibia; lamellar formula for toes 9-15-20-26-17; dorsal scales of tail about three times as large as largest dorsals on body, strongly keeled and mucronate; subcaudal scales smaller and smooth; ventrals on body smooth, rounded, of about equal size except in interfemoral region; ventral interfemorals about one half as large as preanals or abdominals; a distinct demal pouch behind insertion of hindleg.

Color above blue-gray, with small light-blue flecks scattered over sides and a few in the middorsal region; about seven very dim, narrow bands of darker color may be discerned on the back; base of tail with a very few flecks of bright, almost iridescent, blue; all but proximal fifth of tail dimly banded; limbs irregularly and narrowly banded with brown and light; extreme lateral surfaces of body with irregular light spots; a dark blue blotch behind axilla; head light brown; upper labial region dimly banded with brown and whitish, the bands continuous onto the lower labial region; gular region dark blue, some scales lighter, with light diagonal bands continuous with those of the labial region converging toward the median line of throat; extreme lateral surfaces of belly generally dark blue, with a few scales of light blue; a broad median area of belly whitish, suffused with blue; chest and preanal region white; anterior ventral surfaces of hindlimbs bluish, the remainder white; ventral surface of tail white.

Variation. The frontal is divided in all but two of the paratypes (Nos. 255, 500), but it varies much in the manner of division. In some it is divided transversely into three sections; in others either the anterior or the posterior section is divided longitudinally; occasionally, when the posterior section is thus divided, one part or both are fused to the corresponding frontoparietal. There are two large scales regularly present in front of the frontal (usually separated by a smaller scale), and this is preceded by three large scales which contact on either side of the posterior canthal; these scales are frequently variously modified—divided into several, fused together in part or fused with adjoining scales. Between these and the rostral are usually three pairs of median scales, the posterior two pairs of about equal size but much larger than the anterior pair. All are variable. Occasionally five upper and six lower labials occur. In details of scalation they are otherwise much like the type.

In males the dorsal ground color varies from greenish blue to gray, in some specimens light brown. In four or five a dim trace of dark spots on either side of the median dorsal line may be observed; in a few others the spots are fused on the median dorsal line, forming very dim, narrow, darker bands across the back, about seven in number.

Females do not differ from males greatly in coloration. The blue on the ventral surfaces is lighter, while that of the belly is almost entirely absent. The dorsal coloration is brownish gray to light brown; the blue flecks are absent, although the lateral light spots are frequently present. Some specimens are perfectly uniform in color over the entire back and sides; in five the darker spots on either side of the median dorsal line are very dimly visible, as in some males. In no females are they fused to form transverse bands.

Two young specimens are present in the series (No. 258, male, snout to vent measurement 31 mm.; and No. 448, female, snout to vent measurement 26.2 mm.). The larger is uniform brownish-gray over the entire back. The smaller is brownish gray above, with a very dim trace of a series of dorsolateral darker spots, as in some adults. In neither are there light lines along the sides of the neck or body.

Relationships. Uta taylori is unquestionably related to the subspecies of *U. stansburiana*, yet its relationship cannot be close. It differs in the relative proportion of the length of the fourth toe and the snout to gular fold distance; the maximum size is less; the color pattern is very different from that of *U. stansburiana*, and the habitat is different.

The following table gives a summarized comparison of the relative proportion of the length of the fourth toe and the snout to gular fold measurement in *Uta stansburiana stejnegeri*, *Uta s. hesperis* and *Uta taylori.*[*]

SPECIES		Males	Females
stejnegeri:	Maximum	*(16) 1 080	*(8) .966
	Minimum	(16) .800	(8) .800
	Mean	(16) .916	(8) .8801
hesperis:	Maximum	(13) .936	(7) .928
	Minimum	(13) .811	(7) .824
	Mean	(13) 8705	(7) .8697
taylori:	Maximum	(9) .853	(10) .827
	Minimum	(9) .722	(10) .687
	Mean	(9) .7865	(10) .7715

[*] The numbers in parentheses indicate the number of specimens

Full data on scale counts, measurements and proportions of *U. s. stejnegeri* are given in the table accompanying the discussion of that subspecies; the other tables, of *U. s. hesperis*[*] and *U. taylori*, are given below for comparison.

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[*] The specimens of *U. s. hesperis* are in the Kansas University Museum, and were collected in the following localities: No. 12170, Los Angeles Co., Calif., June, 1925; 12156-12157, Montecito, Santa Barbara Co., Calif., Sept. 4-6, 1929; 11878, Kitchen Creek, San Diego Co., Calif., August, 1928; 2178, 2180-2181, Pine Valley, San Diego Co., Calif., May 16, 1926; 12093-12094, 12158-12160, same locality, Sept. 1, 1929; 12175, 12179, 12181, 12185, Palomar Mt., San Diego Co., Calif., August, 1928; 11612, 11617, 11620, 11622, Boulder Park, near Jacumba, San Diego Co., Calif., July 26, 1928.

Measurements and scale counts of *Uta stansburiana hesperis*

I	Number	12093	11878	11617	11620	11612	2181	12094
II	Sex	♀	♀	♀	♂	♂	♂	♀
III	Snout to vent	40.5	42.0	42.5	43.5	44.5	46.0	46.0
IV	Tail	73.0	....	....	....	....	....	....
V	Head width	9.7	9.8	8.5	10.7	9.2	9.9	9.6
VI	Head length	10.0	10.4	9.5	11.0	10.9	11.0	10.5
VII	Snout to gular fold	14.0	15.0	14.5	16.0	15.5	15.5	15.5
VIII	Ratio, VII to III	.348	.357	.341	.367	.348	.336	.336
IX	Foreleg	19.0	19.0	17.0	20.0	19.0	18.5	19.5
X	Hindleg	31.0	31.0	30.0	34.8	34.2	35.5	31.3
XI	Ratio, X to III	.765	.738	.705	.800	.768	.771	.680
XII	Fourth toe	13.0	13.0	12.8	13.0	14.0	14.0	13.0
XIII	Ratio, XII to III	.320	.309	.301	.298	.314	.304	.282
XIV	Femoral pores	14–?	?	14–?	13–14	15–16	15–16	?
XV	Dorsal scales	102	92	83	94	96	84	95
XVI	Ventral scales	62	58	61	60	60	63	63
XVII	Gular scales	28	27	27	33	29	31	28
XVIII	Gular fold scales	17	15	18	18	15	18	18
XIX	Ratio, XII to VII	.928	.866	.882	.817	.903	.903	838

Measurements and scale counts of *Uta stansburiana hesperis*—Continued

I	Number	12185	12179	12181	11622	12159	2180	2178
II	Sex	♂	♀	♀	♀	♂	♂	♂
III	Snout to vent	47.0	47.5	47.7	48.0	48.5	48.5	49.0
IV	Tail	....	71.0	....	....	87.0	77.0	88.0
V	Head width	10.7	9.7	10.0	9.7	10.8	10.5	10.8
VI	Head length	11.5	10.5	10.7	10.0	12.0	11.0	12.0
VII	Snout to gular fold	17.0	15.3	16.0	14.8	16.8	16.2	17.5
VIII	Ratio, VII to III	.361	.322	.335	.308	.346	.334	.357
IX	Foreleg	18.9	18.5	19.0	18.0	18.5	19.5	21.0
X	Hindleg	36.0	32.9	33.0	30.7	33.0	37.2	37.8
XI	Ratio, X to III	.765	.692	.691	.639	.680	.767	.771
XII	Fourth toe	13.8	13.5	13.9	12.4	14.0	14.4	15.0
XIII	Ratio, XII to III	.293	.273	.291	.258	.288	.296	.306
XIV	Femoral pores	13–13	14–16	14–?	14–?	13–?	18–?	15–15
XV	Dorsal scales	87	108	96	90	96	94	101
XVI	Ventral scales	55	64	59	54	64	62	70
XVII	Gular scales	29	28	29	29	34	31	32
XVIII	Gular fold scales	18	16	13	12	17	12	18
XIX	Ratio, XII to VII	.811	.882	.868	.824	.833	.888	.857

Measurements and scale counts of *Uta stansburiana hesperis*—Concluded

I	Number	12158	12175	12160	12157	12170	12156
II	Sex	♂	♂	♂	♂	♂	♂
III	Snout to vent	49.0	50.0	50.5	51.5	51.5	55.5
IV	Tail	....	88.0	....	....	....	....
V	Head width	10.1	10.0	11.9	10.6	11.0	11.5
VI	Head length	11.0	11.5	11.0	11.0	12.0	12.2
VII	Snout to gular fold	17.4	16.5	16.7	17.0	17.5	18.0
VIII	Ratio, VII to III	.355	.330	.330	.330	.339	.324
IX	Foreleg	20.0	19.5	20.5	21.0	21.4	21.8
X	Hindleg	36.5	38.9	35.0	39.0	39.0	39.8
XI	Ratio, X to III	.744	.778	.693	.757	.757	.717
XII	Fourth toe	15.0	15.0	14.4	15.9	15.0	16.0
XIII	Ratio, XII to III	.306	.300	.285	.308	.291	.288
XIV	Femoral pores	13–13	15–15	14–15	15–?	14–14	14–14
XV	Dorsal scales	92	98	88	99	109	107
XVI	Ventral scales	64	60	65	62	66	61
XVII	Gular scales	32	29	31	32	31	28
XVIII	Gular fold scales	15	15	19	15	15	15
XIX	Ratio, XII to VII	.862	.909	.862	.935	.857	.888

Measurements and scale counts of *Uta taylori*

I	Number	202	199	256	257	255	281	323a
II	Sex	♀	♂	♂	♀	♀	♀	♀
III	Snout to vent	40.0	41.5	42.0	42.0	42.0	43.0	44.0
IV	Tail	....	....	....	63.5	69.0	....	....
V	Head width	8.8	9.5	9.3	8.0	8.0	9.0	8.5
VI	Head length	102.	10.5	10.1	9.9	10.0	10.0	10.5
VII	Snout to gular fold	14.8	15.1	16.0	15.0	14.8	15.1	16.0
VIII	Ratio, VII to III	.370	.363	.380	.357	.352	.351	.363
IX	Foreleg	19.5	19.5	20.0	19.0	19.0	19.0	18.0
X	Hindleg	31.5	....	35.0	32.0	31.5	30.5	30.5
XI	Ratio, X to III	.787	....	.833	.761	.750	.709	.670
XII	Fourth toe	12.0	....	13.3	12.0	12.0	11.2	11.0
XIII	Ratio, XII to III	.305	....	.316	285	.285	.260	.250
XIV	Femoral pores	16–17	16–16	14–16	13–14	15–16	13–16	16–17
XV	Dorsal scales	110	92	105	102	102	103	108
XVI	Ventral scales	59	56	59	56	55	59	57
XVII	Gular scales	32	28	36	30	28	31	29
XVIII	Gular fold scales	15	14	16	20	16	19	17
XIX	Ratio, XII to VII	.810	....	.831	.800	810	.741	.687

Measurements and scale counts of *Uta taylori*—Continued

I	Number	280	320	284	393	500	304	320a
II	Sex	♀	♀	♀	♂	♂	♀	♂
III	Snout to vent	44.5	44.5	45.0	45.0	45.5	46.5	46.7
IV	Tail	....	....	....	84.0	....	....	79.0
V	Head width	8.9	8.9	9.0	9.7	9.5	8.8	9.6
VI	Head length	10.9	10.0	11.0	11.8	11.0	10.5	11.7
VII	Snout to gular fold	15.0	14.5	16.2	16.4	....	16.0	16.3
VIII	Ratio, VII to III	.337	.325	.360	.364	....	.344	.349
IX	Foreleg	20.0	18.0	19.5	22.0	....	20.0	22.0
X	Hindleg	32.5	31.0	33.5	36.5	....	34.5	34.0
XI	Ratio, X to III	.730	.696	.744	.811	....	.741	.728
XII	Fourth toe	12.2	12.0	12.0	14.0	13.5	12.0	13.0
XIII	Ratio, XII to III	.274	.269	.266	.311	....	.258	.278
XIV	Femoral pores	13–14	14–15	17–17	15–16	16–?	14–14	14–14
XV	Dorsal scales	108	109	111	108	106	106	102
XVI	Ventral scales	57	57	62	63	....	65	60
XVII	Gular scales	30	29	33	33	....	31	35
XVIII	Gular fold scales	22	17	21	19	....	20	15
XIX	Ratio, XII to VII	.813	.827	.740	.853	....	.750	.797

Measurements and scale counts of *Uta taylori*—Concluded

I	Number	282	283	474	254	335	322	450
II	Sex	♀	♂	♂	♂	♂	♂	♂
III	Snout to vent	47.0	48.0	48.0	48.0	48.0	48.0	48.0
IV	Tail	74.0	82.0	....	87.0	....	81.0	....
V	Head width	9.0	9.8	9.9	9.7	....	9.5	10.0
VI	Head length	10.7	11.3	11.0	11.0	11.8	11.5	12.0
VII	Snout to gular fold	16.0	16.5	16.0	17.5	18.0	17.5	17.8
VIII	Ratio, VII to III	.340	.343	.333	.364	.375	.344	.370
IX	Foreleg	20.0	21.5	21.0	21.5	20.0	20.0	22.0
X	Hindleg	34.0	37.0	35.5	37.0	35.5	37.5	....
XI	Ratio, X to III	.723	.770	.739	.770	.739	.781	....
XII	Fourth toe	11.8	13.0	12.8	14.0	13.0	13.8	14.0
XIII	Ratio, XII to III	.287	.270	.266	.291	.270	.311	.291
XIV	Femoral pores	14–14	15–15	16–17	15–17	14–15	14–14	16–?
XV	Dorsal scales	116	117	105	104	108	105	111
XVI	Ventral scales	61	61	65	66	61	57	64
XVII	Gular scales	30	33	33	32	30	31	32
XVIII	Gular fold scales	20	16	15	21	18	13	22
XIX	Ratio, XII to VII	.737	.787	.725	.800	.722	.788	.786

The maximum length, from snout to vent, which males of *U. taylori* reach is about 48 mm.; males of *U. stansburiana stejnegeri* frequently attain a length of 54 mm.; and males of *U. stansburiana hesperis* frequently are 50 mm. long, occasionally reaching 55 mm.

All subspecies of *Uta stansburiana* possess the same basic color pattern: lateral light lines on the neck and sides of body, especially distinct in the young, and distinct dorsal spots, only occasionally indistinct in large males. No lateral light lines are present in *U. taylori*, and the dorsal darker spots are always indistinct and usually entirely absent or modified to form transverse bands.

Uta stansburiana is typically a lizard of the open desert areas, not frequenting rocks except as they occur in small scattered groups in more or less level areas or at the bases of hills. *Uta taylori*, on the other hand, frequents only rock cliffs of desert mountains, shunning the open desert plains. They are much more wary than *U. stansburiana*, and much less conspicuous.

In relation to its habitat, it is interesting to note that *U. taylori* possesses much shorter and stouter claws than either *U. s. stejnegeri* or *U. s. hesperis*. It is to be assumed that this difference is directly related to an environmental influence, *U. stansburiana* occupying an ecological niche which, because of its lesser "resistance," would permit a greater claw length than would the more "resistant" niche which *U. taylori* occupies, where short, stout claws with a clinging and more or less grasping power are essential.

It may be noted that *U. taylori* differs from *U. s. stejnegeri* also in the regular presence of a distinct dermal pocket behind the insertion of the hindleg. In *U. s. stejnegeri* this pocket is rarely present in males, and never in females. It is regularly present, however, in *U. s. hesperis*. Another difference is the greater number of dorsal scales from the interparietal to the base of the tail in *U. taylori*. Thirdly, the enlarged dorsal scales of *U. taylori* are abruptly differentiated from the laterals only a short distance anterior to the hindlegs.

The presence of this species in Sonora might suggest the possibility of its being identical with some form of Baja California. However, it would appear that it is only remotely related to these described forms, with the possible exception of *U. elegans*, a species whose identity has long been a problem. It has frequently been considered a synonym of *U. stansburiana*, and numerous authors have placed the species with the form now known as *U. stansburiana* *stejnegeri* Schmidt (1922), who regarded *U. elegans* as a distinct species, distinguished it from *U. stansburiana* by the greater ratio of the length of the hindleg to the snout-vent measurement (.74 to .85 in 18 males, average .80), and by the different average number of dorsal scales from the interparietal to the base of the tail (max. 106, min. 82, av. 91, in twenty specimens). In these characters *U. elegans* can be seen to be quite different also from *U. taylori.* No specimens of *U. elegans* have been available for comparisons, but on the bases of nonconformity with the diagnostic characters of *U. elegans* as shown by Schmidt, of the closer relationship of this form to *U. stansburiana*, and of geographic probabilities, I here consider *U. taylori* as distinct from *U. elegans.*

Remarks. The species is named for Dr. Edward H. Taylor, who collected the specimens and very kindly permitted me to study and describe them.

Uta stansburiana stejnegeri Schmidt

Fifty-two specimens of this form are in the collections, from the following localities: Sonora: Near Empalme, July 13, 1934 (EHT Nos. 501-503, 514-516a). Durango: Near Avilco, August 25, 1932 (EHT and HMS Nos. 4389-4390); 5 miles north of Conejos, June 25, 1934 (DHD and HMS Nos. 294-295); 25 miles north of Bermejillo, June 27, 1934 (DHD and HMS No. 340). Coahuila: 10 miles east of Torreón (EHT and HMS Nos. 4388, 4409; August 30 and 25, 1932, respectively); near San Pedro, August 30, 1932 (EHT and HMS Nos. 4308, 4491-4514); 5 miles south of San Pedro, June 29, 1934 (DHD and HMS Nos. 345, 363-367); near deserted village 30 miles west of La Rosa, August 30, 1932 (EHT and HMS Nos. 4526-4532, 4570). Chihuahua: 15 miles south of Juárez, June 19, 1934 (DHD and HMS Nos. 78, 79).

The specimens do not differ to any marked extent from those in the Kansas University Museum from New Mexico, Arizona and western Texas. The specimens from Empalme, Sonora, show no closer approach to *Uta taylori,* collected not more than ten miles north, than do other specimens from Mexico and the United States. The dorsal scales are larger in size and smaller in number from the interparietal to the base of the tail, and are abruptly differentiated from the laterals, anterior to the sacrum, more than half the distance between the groin and axilla. The postfemoral dermal pocket is present in only one large male; the average ratio of the length of the fourth toe to the distance from snout to gular fold is that of *U. s. stejnegeri*, not *U. taylori;* and the color pattern is distinctly that of *U. stansburiana* and its subspecies, with two lateral light lines on the neck (and on the body in the young) and distinct dorsolateral dark spots in some specimens of both sexes. The specimens were collected in a habitat not frequented by *U. taylori:* three were taken on a sandy beach near the ocean, and the others in a desert plain about a mile from the beach.

The subspecies has been reported in Mexico from northeastern Baja California (Meek, 1905; Schmidt, 1922), Sonora (Tepoca Bay, San Pedro Bay, Tiburon Is., Patos Is., Pelican Is.; Van Denburgh, 1922) and Chihuahua (Richardson, 1915). The specimens of *U. stansburiana* collected by Mearns at Poso de Luis and Sonoyta in Sonora, and reported by Cope (1900), probably belong to the subspecies *stejnegeri*.

Measurements and scale counts of *Uta stansburiana stejnegeri* Schmidt

I	Number	4501	4500	4491	503	4503	4499	514
II	Sex	♀	♀	♀	♀	♂	♀	♂
III	Snout to vent	30.0	33.8	34.0	34.0	35.0	36.0	39.5
IV	Tail	....	....	....	....	....	....	....
V	Head width	6.7	8.0	7.2	7.5	7.5	8.0	8.0
VI	Head length	7.4	8.7	8.0	8.5	9.0	8.5	9.2
VII	Snout to gular fold	12.1	....	12.5	12.5	12.5	13.5	14.0
VIII	Ratio, VII to III	.403	....	.367	.367	.357	.375	.354
IX	Foreleg	13.8	15.5	14.5	15.0	16.0	16.5	16.8
X	Hindleg	21.5	23.0	26.5	27.0	27.5	30.0	31.2
XI	Ratio, X to III	.716	.696	.779	.705	.785	.805	.789
XII	Fourth toe	11.7	12.5	11.0	10.5	13.5	12.8	13.0
XIII	Ratio, XII to III	.390	.369	.323	.308	.357	.355	.329
XIV	Femoral pores	13–?	....	16–15	14–15	14–16	15–15	13–14
XV	Dorsal scales	85	88	87	88	87	84	98
XVI	Ventral scales	60	65	64	64	60	66	60
XVII	Gular scales	31	31	28	31	30	33	34
XVIII	Gular fold scales	11	....	16	16	14	15	15
XIX	Ratio, XII to VII	.966	....	.880	.840	1.08	.948	.928

Measurements and scale counts of *Uta stansburiana stejnegeri* Schmidt
—Continued

I Number	4502	4509	516a	501	502	516	4532
II Sex	♂	♀	♀	♂	♂	♂	♀
III Snout to vent	40.0	40.3	43 0	45.0	46 0	47.5	48.0
IV Tail	76.0	74.3	....	96.0	96 0	89.0	....
V Head width	8.0	8.3	9.0	10.7	....	....	9.2
VI Head length	9 1	9.5	10.5	11.5	.....	....	10.7
VII Snout to gular fold	14 3	14.0	15.5	16.2	....	....	17.3
VIII Ratio, VII to III	.357	.347	.360	.360	....	....	.360
IX Foreleg	17.8	18 8	19.0	20.0	21.0	19.5	21.0
X Hindleg	30.0	32.0	31.0	38.5	36.5	36.0	36.5
XI Ratio, X to III	.750	.794	.720	.855	.797	.757	.760
XII Fourth toe	14.0	13.8	12.8	15.0	15 0	15.0	14.2
XIII Ratio, XII to III	.350	.342	.297	.333	.326	.315	.295
XIV Femoral pores	17–?	15–15	....	15–16	15–16	15–?	15–15
XV Dorsal scales	88	87	94	91	93	90	82
XVI Ventral scales	66	67	56	67	59	64	61
XVII Gular scales	30	34	30	30	28	....	31
XVIII Gular fold scales	13	18	16	15	17	17	17
XIX Ratio, XII to VII	.979	.985	.802	.925	....	....	.820

Measurements and scale counts of *Uta stansburiana stejnegeri* Schmidt
—Continued

I Number	4508	4498	515	4504	4496	4530	4531
II Sex	♂	♂	♂	♀	♂	♂	♂
III Snout to vent	51.0	51 0	51.0	51.3	51.8	52.0	53.0
IV Tail	90.0	82 5	....	81.0	95.5	110.0	101.0
V Head width	10.0	10.0	10.0	9.1	10.5	10.6	10.3
VI Head length	11.0	11.0	11.5	10.2	11.0	11.0	11.3
VII Snout to gular fold	18.8	18.5	17.5	18.0	18.0	18.0	17.5
VIII Ratio, VII to III	.368	.362	.343	.350	.347	.346	.330
IX Foreleg	22.5	20.5	20.0	19.1	23.0	22.1	23.2
X Hindleg	39.0	39.0	37.5	35.2	41.0	39.3	41 5
XI Ratio, X to III	.764	.764	.735	.688	.791	.755	.783
XII Fourth toe	16.0	16 0	13.5	14.4	16.2	17.0	17.0
XIII Ratio, XII to III	.315	.313	.313	.280	.312	.326	.321
XIV Femoral pores	15–16	14–14	14–16	16–?	15–14	15–15	15–15
XV Dorsal scales	85	87	92	91	85	86	84
XVI Ventral scales	63	63	61	68	65	61	64
XVII Gular scales	28	28	31	34	34	30	30
XVIII Gular fold scales	17	16	16	17	16	15	15
XIX Ratio, XII to VII	.851	.864	.800	.800	.900	.944	.971

Measurements and scale counts of *Uta stansburiana stejnegeri* Schmidt
—Concluded

I	Number	4529	4495	4497	4493	4492	4527
II	Sex	♂	♂	♂	♂	♂	♂
III	Snout to vent	53.0	53.5	54.0	54.0	54.0	54.8
IV	Tail	....	96.7	102.0	....	....	....
V	Head width	10.2	11.0	11.0	11.2	10.5	11.0
VI	Head length	11.0	11.5	11.3	11.5	12.0	12.0
VII	Snout to gular fold	18.3	19.0	17.2	18.8	18.5	19.0
VIII	Ratio, VII to III	.345	.355	318	.348	.342	.346
IX	Foreleg	23.0	21.0	23.0	22.0	....	23.8
X	Hindleg	40.0	40.0	42.0	41.0	38.0	42.5
XI	Ratio, X to III	754	.747	.777	.759	.703	.773
XII	Fourth toe	16.1	16.1	17.3	17.0	16.8	17.0
XIII	Ratio, XII to III	.303	.300	.320	.314	.311	.310
XIV	Femoral pores	14–15	15–15	15–15	16–15	15–16	14–14
XV	Dorsal scales	84	81	89	88	85	90
XVI	Ventral scales	59	60	65	62	60	60
XVII	Gular scales	30	30	30	28	31	30
XVIII	Gular fold scales	12	17	14	16	15	16
XIX	Ratio, XII to VII	.879	.847	1.000	.904	.903	.894

Uta bicarinata (Duméril)

Fifteen specimens were collected during the summer of 1932, by Dr. Edward H. Taylor and myself, in the following localities: Guerrero: 11 miles southwest of Puente de Ixtla, June 22 (EHT and HMS Nos. 672-675, 750); near Junction of Mexico-Acapulco highway and Rio Balsas (EHT and HMS Nos. 839, 1581, June 23 and July 2, respectively); 12 miles south of Chilpancingo, June 26 (EHT and HMS Nos. 1018-1019); 2 miles north of Agua Bendita, July 3 (EHT and HMS No. 1626). Morelos: Near Puente de Ixtla, July 4 (EHT and HMS Nos. 1627-1628); 4 miles south of Cuernavaca, June 22 (EHT and HMS Nos. 718-720). Oaxaca: Near Chasumba, July 28 (EHT and HMS No. 3212).

In two specimens the frontal is transversely divided posteriorly, and the posterior section is divided longitudinally; in four other specimens the frontal is greatly reduced in size, apparently the posterior portion having been separated and fused with the frontoparietals, which are proportionately increased in size. The character of the median rows of enlarged dorsals varies considerably in the series. In some specimens the rows are continuous and unbroken from the nape to the tail, but in most specimens the rows are distinctly broken into four sections by the replacement of the large scales, at more or less regular intervals, by granular scales. In the large males the alternation of granules and enlarged scales is very conspicuous. There are regularly present five longitudinal rows of enlarged tubercles on the sides, the lower row in contact with the ventrals about midway between the forelegs and hindlegs. The series of enlarged dorsals begin on the shoulders, although there are numerous scattered enlarged tubercles on the neck, sometimes forming two short series, more widely separated than the dorsal rows on trunk. The ear is bordered anteriorly by a few large granules, which are sometimes elongated. The ventrals are distinctly, although not strongly, mucronate. It is noteworthy that the pocket behind the insertion of the hindleg which is present in *U. ornata* and its subspecies, as well as certain others, is absent in *U. bicarinata*.

The dorsal surfaces are grayish; a neck band of darker gray or black is visible in all specimens; posterior to this and anterior to the base of the tail are four broad transverse bands, in some cases partially or completely interrupted on the median dorsal line, and in some males almost or quite invisible; in some specimens narrow dark bands are visible on the tail. In males the sides of the belly are whitish, sometimes suffused with orange, and the broad median area is blue, darker anteriorly; the breast and lower surfaces of limbs and tail are whitish, sometimes lightly suffused with blue or orange; the entire gular region is orange, coarsely reticulated or diagonally barred with black except in a large, round median area just anterior to the gular fold. The coloration of the gular region is very similar in females; the blue of the belly is lacking, but there are present instead numerous black spots, indefinitely outlined.

The specimen from Oaxaca differs in a number of respects from the others of the series. The ventrals are abruptly differentiated from the laterals, and are of almost uniform size, not decreasing laterally. They are more strongly mucronate and weakly keeled near the sides of the belly. The scales bordering the gular fold extend beyond the middle of the insertion of the foreleg, and are as large on the sides as in the median line, and weakly keeled. The median gular area, which is immaculate in the other specimens, is irregularly spotted with black. Otherwise, in scalation, proportions and coloration, the specimen is within the range of variation shown in the other specimens.

The species is apparently entirely arboreal. Some specimens were found on some of the large species of cacti of the genus Opuntia. Their coloration is extremely protective; they were frequently discovered only by striking likely-looking trees with a shovel or heavy stick. Usually two or more occurred together on the same tree or cactus.

U. bicarinata has been reported from the following states: Guerrero (Gadow, 1905); Colima (Dugès, 1896); Tepic (Dugès, 1896); Sinaloa (Boulenger, 1885; Günther, 1890); Jalisco (Günther, 1890); Durango (Boulenger, 1885; Günther, 1890); Guanajuato (Dugès, 1896); Morelos (Boulenger, 1885; Günther, 1890); Oaxaca (Sumichrast, 1880); Puebla (Bocourt, 1874; Cope, 1885, 1887; Ferrari-Perez, 1886; Günther, 1890); Michoacán (Dugès, 1896); and Chihuahua (Cope, 1887, 1900; doubtful). It is probable that a number of the above records are based upon specimens which actually belong to some of the species recently described by Schmidt (1921), which are related to or superficially resemble *U. bicarinata*.

Uta tuberculata Schmidt

(Plate XXVI, fig. 1)

A single specimen (EHT No. 552, male) was collected by Taylor fifteen miles south of Presidio de Mazatlán, Sinaloa, Mexico, July 19, 1934.

Although similar to *Uta bicarinata*, the species is apparently very distinct. The specimen agrees with most diagnostic characters proposed by Schmidt (1921) except that the head is shorter, not longer, in proportion to the snout-vent measurement than is the head of *U. bicarinata,* and the preauricular spines are of about the same size in the two species. Dr. G. K. Noble, who has kindly had this specimen compared with the type and paratypes of *U. tuberculata,* states that these two characters are exaggerated in the type, and that our specimen compares well with the paratype series.

The enlarged granules on the back and sides are disposed in five longitudinal series; the lower series is in contact with the ventrals at a point halfway between the axilla and groin. The enlarged tubercles are proportionately larger than those of *U. bicarinata.* The ventrals are very slightly mucronate or rounded; in *U. bicarinata* they are more strongly mucronate, much more so toward the sides of the abdomen. The color pattern is practically identical in the two species.

The measurements are as follows: snout to vent, 41 mm.; tail, 62 mm.; total length, 103 mm.; ratio, tail to total length, .601; foreleg, 18 mm.; hindleg, 25 mm.; length of head, 9.5 mm. (to anterior margin of ear); breadth of head, 8.2 mm.

Uta caerulea sp. n.

(Plate XXVI, fig. 2)

Holotype. Male, DHD and HMS No. 132, collected about thirty miles north of Chihuahua City, Chihuahua, Mexico, June 21, 1934.

Paratypes. Twelve, including DHD and HMS Nos. 127-131 and 133, collected with the type; and Nos. 138-143, collected about twenty miles south of Chihuahua City, June 22, 1934; all collected by David H. Dunkle and Hobart M. Smith.

Diagnosis. Frontal divided; a series of enlarged, weakly keeled dorsals on either side of the median dorsal line, beginning on shoulders and continuing posteriorly to the base of tail; about two rows of small, weakly keeled scales on median dorsal line of body, one row continuing onto tail a distance about equivalent to length of femur; dorsolateral row of tubercles indistinct; oblique and lateral rows of tubercles absent, as well as lateral fold; scales on dorsal surface of tibia much larger than any of the enlarged dorsals on body; head as broad as long (measured to the posterior edge of interparietal) or broader; males with the entire ventral surfaces of body and tail, except chest, base of tail and an area between the hind legs, sky blue; dorsum with about seven transverse black bars on each side; bars usually blue-edged.

Description of Type. Head scales smooth, flat; frontal divided; interparietal more or less triangular in shape, about as long as broad, very narrowly in contact with frontal; one frontoparietal and one enlarged parietal on each side; a series of small scales bounding inner margin of orbit; a series of five to six enlarged supraorbitals, separated from the superciliaries by two or more rows of small scales; anterior fourth or fifth of orbital region occupied by small scales; three canthals, the anterior terminating below the nostril; nasals separated from rostral and upper labials by a single row of small scales, and from each other by two large internasals; rostral narrowly in contact with internasals; a single loreal, separated from upper labials by two rows of small, elongate scales; five superciliaries, the one immediately above eye overlapped at either end by the adjacent superciliary; one enlarged, heavily keeled, pentagonal preocular; a long, heavily keeled subocular, contacting preocular; two small, elongate, moderately keeled scales bordering orbit posterior to subocular; four upper and six (right) or seven (left) lower labials to a point below middle of eye; mental sharply angular, pentagonal, its labial border slightly more than half that of rostral; two large scales in contact with mental posteriorly, and with each other on the median line; these two scales followed posteriorly by a row of scales gradually diminishing in size, and separated from the labials anteriorly by one row of small elongate scales, posteriorly by three; scales of gular region small, rounded, not imbricate except near gular fold, where they become somewhat triangular and slightly larger, especially on the edge of the gular fold; granular scales of gular fold more numerous toward sides, almost lacking on median ventral line; temporal scales small, those between eye and ear smallest, those between parietals and upper edge of ear larger; three large, smooth, triangular lobules on anterior edge of ear, the median extending about one-third of the distance across; ear oval, its vertical diameter greatest, less than the length of interparietal; a deep lateral cervical pouch about halfway between ear and anterior border of insertion of foreleg; a longitudinal fold from near upper border of ear to upper edge of lateral cervical fold, and from there to upper edge of gular fold, surmounted by slightly enlarged granules, largest and most numerous anteriorly; a group of enlarged granules on side of neck above and between lateral cervical fold and ear, separated by five or six granules from a smaller group of enlarged tubercles posterior to the former group; other scales on neck granular; enlarged dorsals beginning on neck, continuing posterior in two rows on either side of median dorsal line, weakly keeled, the inner row largest; enlarged dorsals between hind legs smaller, in four or five rows on either side; two rows of small scales on middorsal line, weakly keeled, continuing onto tail a distance slightly greater (measured from posterior margins of hind legs) than length of femur; an indistinct dorsolateral series of small tubercles, mostly keeled, beginning behind shoulders and terminating above hind leg; a few very slightly enlarged tubercles on sides, not disposed in a longitudinal series; no lateral fold; dorsal scales of foreleg keeled, except on digits, the larger scales larger than dorsals on body; ventral scales of upper foreleg very small, almost granular, those on lower foreleg much larger, smooth; scales under foot keeled, mucronate; lamellar formula for fingers 8-12-15-16-12; ventrals on body small, smooth, rounded and imbricate, of about equal size except those near groin, which are smaller; scales on anterior surface of femur larger than dorsals on body, keeled, becoming smaller and smooth toward femoral pores; posterior surface of femur with granular scales which continue dorsally to the middle of the femur, where they are in contact with the abruptly enlarged anterior scales; dorsals of tibia larger than scales on femur, keeled, the ventrals smaller, smooth; scales on foot keeled, the ventrals mucronate; lamellar formula for toes 8-12-17-23-17; caudal scales more or less uniform, rather weakly keeled; 27 scales around fifth verticil; scales at sides of tail granular; a dermal pocket behind insertion of hind leg.

A broad, black band present from shoulder to lower posterior margin of orbit, touching upper edge of ear and becoming lighter anteriorly; a very distinct narrow, black line from anterior margin of insertion of foreleg to the longitudinal black band above; a light band, with scattered areas of light blue, from axilla to groin; seven undulating black bars across back, bordered by sky blue, the posterior two bars indistinct; neck, area between the blue on sides, occipital region of head, median dorsal areas between the black bands, also the base of tail, bluish gray; some of black crossbars branching on sides; anterior portion of head grayish, mixed with areas of sky blue; forelimbs grayish, with a few small areas of blue, and about seven narrow black bands; hind legs mostly grayish, with areas of blue surrounding the few irregular black bands; tail bluish gray, with indistinct bands of black; sides of body below light line reticulated with light blue and black; belly entirely blue, darker in median area and with a few lines of darker blue on sides; chest, portion of gular region posterior to lateral cervical folds, and ventral surfaces of limbs dirty white; entire gular and labial region anterior to lateral cervical folds uniform sky blue; anal region blue, separated by a dirty white area, confluent with that of hind limbs, from the blue of belly; tail dirty white at base, blue and gray predominating posteriorly.

Variation. Females lack entirely the blue coloration characteristic of the males. The dorsum is light gray, the head lighter; the dark transverse bars on back and limbs are but very dimly visible. The ventral surfaces are whitish, with a few streaks or spots of black on the sides of the abdomen and in the labial region.

In diagnostic scale characters the paratypes are quite uniform and much like the type. The cephalic scales, as in other species of Uta, vary considerably. The enlarged dorsals are small and weakly keeled in all specimens, much smaller than the large scales on the dorsal surface of the tibia. In all specimens the small scales between the series of enlarged dorsals on body continue onto the tail a distance about equal to the length of the femur. The gular fold is in most specimens distinctly separated for its entire length from the ventrals on chest; in three there is but a single row of granules on the median ventral line in the gular fold. As shown in the table of measurements, the width of the head is in all paratypes equal to or greater than the length (measured to the posterior margin of the interparietal). The dorsolateral row of tubercles is indistinct, and the lateral row of tubercles and the lateral fold are absent.

The male paratypes are approximately the same in coloration as the type. The dark, transverse bands across the body are usually interrupted medially. Most striking is the general suffusion of blue over the entire dorsal and ventral surfaces, especially on the latter. In one very dark specimen (No. 143) the back is almost entirely black, the blue being confined to bars and spots on the sides. The entire belly is blue, coarsely reticulated with black on the sides; the chest, ventral surfaces of limbs and the area between the hind limbs are heavily suffused with blackish.

In a younger male (No. 142), the blue in the gular region is confined to a small median area, and the blue on the belly is confined to elongate lateral patches, as normally occurs in the fully adult males of *U. ornata ornata*.

Measurements and scale counts of *Uta caerulea*

Number	140	139	142	133	138	141
Sex	♂	♀	♂	♂	♂	♂
Snout to vent	42.0	43.0	44.0	44.0	44.3	46.0
Tail	....	54.2	.....	65.5	....	....
Head width	9.5	8.5	9.7	.	9.0	10.0
Head length	9.5	8.5	9.0	9.6	9.0	9.5
Scales to head length	19	12	15	15	15	14
Snout to gular fold	15.0	14.2	14.5	14.5	16.0	16.0
Foreleg	18.0	15.9	17.5	19.5	19.5	18.5
Hind leg	27.5	22.5	30.5	29.0	30.0	29.0
Fourth toe	11.0	9.5	11.5	12.0	11.2	10.8
Lamellae, fourth toe	22–?	19–19	21–21	19–19	19–21	19–20
Femoral pores	?	9–10	11–12	11–11	12–13	11–11

Measurements and scale counts of *Uta caerulea*—Concluded

Number	129	128	143	130	131	132	127
Sex	♂	♀	♂	♂	♂	♂	♂
Snout to vent	46.8	48.1	49.0	49.0	49.0	49.5	50.5
Tail	....	70.0	....	....	66.5	68.5	....
Head width	10.0	9.0	10.0	10.0	10.0	10.0	10.5
Head length	10.0	9.0	10.0	10.0	10.0	10.0	10.2
Scales to head length	15	13	12	16	14	15	14
Snout to gular fold	16.6	15.5	16.0	16.3	17.0	16.5	17.5
Foreleg	21.0	18.0	19.2	20.0	20.0	20.0	20.5
Hind leg	31.5	28.0	29.8	28.5	32.0	30.0	32.5
Fourth toe	12.2	10.9	11.0	12.0	12.2	12.5	12.5
Lamellae, fourth toe	22–23	20–21	21–21	20–20	19–19	23–?	20–21
Femoral pores	10–12	10–12	10–10	10–10	11–12	11–12	10–11

Comparisons. This species is apparently most closely related to *U. ornata ornata.* It differs from this in the possession of a much broader head (longer than broad in *U. ornata,* usually about 10 percent) and a broader, heavier body; the small scales between the rows of enlarged dorsals continue onto the base of the tail a distance about equal to the length of the femur (only a very short distance in *U. ornata ornata*); the tubercles on the dorsolateral line are smaller and fewer; the lateral fold and the enlarged lateral tubercles normally found in *U. ornata ornata* are absent; the enlarged dorsals are smaller in *U. caerulea,* much smaller than the enlarged scales on the dorsal surface of the tibia (of about the same size or larger in *U. ornata ornata*); and the coloration is much different in the males. Males of *U. caerulea* never have an orange throat, and the blue which replaces it extends over the entire labial region, while in *U. ornata* the blue, if present, is sharply differentiated from the whitish labial region. Blue is rarely present in the dorsal coloration of *U. ornata ornata,* and the lateral blue areas on the abdomen of males do not fuse to the extent shown in *U. caerulea.*

U. caerulea differs from *U. ornata symmetrica* as it does from *U. ornata ornata;* it lacks also the oblique rows of tubercles on the sides of the body. *U. ornata lateralis* differs in that the enlarged dorsals begin on the neck instead of on the shoulders.

Remarks. A postfemoral dermal pocket is now known to be regularly present in *U. ornata* and its subspecies, *U. caerulea, U. levis, U. stansburiana hesperis* and *U. taylori,* and is variable in certain other species and subspecies. The presence of this pocket in certain forms of Uta, combined with other characters, is extremely interesting from a phylogenetic standpoint.

It has been recently pointed out (Smith, 1934) that in certain species of Sceloporus of the *S. variabilis* group there is present a rudimentary gular fold immediately in front of the arm which is homologous to the gular fold present in Uta. In Sceloporus it is most distinct in *S. couchii* and *S. merriami*. In the former species, there is present also a distinct dermal pouch immediately behind the insertion of the hind leg. The dorsal scales are extremely small for the genus, the laterals are minute, and the size of the species itself is small.

In *Uta levis* (as well as in the related *U. ornata*) the gular fold is remarkably poorly developed. It is frequently interrupted medially, the scales of the gular region passing directly into the ventrals; in many cases in which the fold is not thus completely interrupted, small scales replace medially the tiny lateral granules. In *U. levis* the lateral scales are uniform in size and very minute—practically granular—but visibly imbricated. The enlarged dorsals are in some specimens in several rows, gradually decreasing in size laterally and grading into the lateral scales. There is present also the dermal pocket behind the insertion of the hind leg, as in *S. couchii*. Its size is comparable with that of the latter.

It is not a far cry from the smaller, almost granular lateral scales of *Uta levis* to the larger, but yet minute, laterals of *S. couchii;* nor is it impossible to conceive of an increase in size of the lateral dorsals from a few rows of enlarged scales to several or many. The rudimentary gular fold of *S. couchii* is comparable with the partially developed fold of *U. levis*. A dermal pocket behind the insertion of the hind leg is present in each, and the sizes of the species are comparable.

It may be stated that the nearest point of contact between the two genera, so far as it can be traced in living forms, is between the species *levis* of Uta and *couchii* of Sceloporus. It cannot be said that either gave rise to the other; it is more likely that the two diverged from an ancestral type not greatly different from the above two species—Sceloporus perhaps later than Uta. By this view the *variabilis* group (to which *couchii* belongs) is the most primitive of the genus, while the *torquatus* group is probably the most highly developed, unless Sceloporus is of diphyletic origin. By the same token, the *ornata* group of Uta (to which *levis* belongs) may be considered the most primitive of its genus, while the *mearnsi* group is probably the most highly developed.

Habits. The specimens from north of Chihuahua City were collected on large boulders on steep hillsides, usually near the top. The males were brilliantly colored and could be seen as far as the eye could distinguish objects of their size. They were rather wary, but occasional specimens were caught by hand. The females, because of their lighter coloration, were difficult to distinguish on the gray limestone rocks which they frequented. Scattered small trees were present on the hillsides, but no Utas were found on them.

The specimens from south of Chihuahua City were collected in a similar habitat, except that the brush was scant and trees absent. Some specimens were found under rocks, probably having sought refuge there upon our approach.

Uta ornata ornata (Baird and Girard)

A single male specimen (DHD and HMS No. 72) was collected on red granite rocks in the hills three miles south of Samalayuca, Chihuahua, Mexico, on June 19, 1934.

The characters of this specimen are obviously those of *U. ornata ornata*, and show no tendency toward intergradation with *U. caerulea*. The scales on the dorsal surface of the tibia and anterior surface of the femur are subequal and approximately of the same size as the enlarged dorsals on body; the small scales between the rows of enlarged dorsals continue back onto the tail base only a few millimeters beyond the posterior margins of the hind legs; the head is narrower than in *U. caerulea* and the granular scales are lacking in the middle of the gular fold, this being almost obsolete medially; the gular region in life was orange, with a median bluish area; and, although the snout to vent measurement is about equal to that of the largest specimen of *U. caerulea,* the blue patches on either side of the belly are distinct, separated medially by six to seven scale rows.

Both the dorsolateral and lateral rows of tubercles are indistinct, although present. A certain amount of blue is present in the dorsal coloration, about the black transverse lines.

Snout to vent, 48.5 mm.; tail, 82.0 mm.; snout to posterior margin of interparietal, 10.0 mm.; width of head, 9.8 mm.; snout to gular fold, 16.3 mm.; foreleg, 20.0 mm.; hind leg, 32.5 mm.; base of fifth toe to end of fourth, 12.3 mm.; scales to head length, 13; scales under fourth toe, 22-23; femoral pores, 13-14.

Apparently the only record of this form from Mexico is that of Gadow (1905, p. 194), who mentions specimens (designated as *Uta elegans*) from Juárez, Chihuahua. The specimens of *U. bicarinata*, mentioned by Cope (1887, p. 35), from the City of Chihuahua are more likely *U. caerulea* than *U. ornata ornata;* it is very improbable that they are actually *U. bicarinata.* Cope mentions with these, specimens from Batopilas, Chihuahua. Since this locality is on the western slope of the Sierra Madre, it is highly improbable that the specimens are *U. ornata ornata,* and it is quite as unlikely that they are *U. bicarinata.* Before the exact identity of these specimens can be stated, a reexamination of them will be necessary.

Uta ornata lateralis (Boulenger)

Thirty-nine specimens were secured by Taylor during the summer of 1934 in the state of Sonora, at the following localities: Eight miles south of Magdalina, June 20 (EHT No. 78); near Noria, June 20 (EHT Nos. 85, 86); 30 miles south of Noria, June 22 (EHT Nos. 107, 108, 109, 109a); five miles southwest of Hermosillo (EHT Nos. 130, 138, 139, June 23; Nos. 183-185, June 25); ten miles northwest of Guaymas (EHT Nos. 251, 251a, 251b, 251c, June 30; Nos. 275-278, 291, July 1; No. 309, July 3; Nos. 337, 338, 338a, July 4; No. 1140a, August 5); near Miramar (EHT Nos. 355-357, July 5; Nos. 405, 405a, 405b, July 7; Nos. 498, 499, July 13).

The ventral coloration of the males in the series is peculiarly variable, probably due in part to the extreme chromatic variability of individuals in life. The gular region is in two specimens brilliant and iridescent bluish, without a trace of yellow or orange. In two other specimens the gular region is lighter blue. In the remainder of the series, the gular region is either white (occasional males of moderate size [50.5 mm. snout-vent], most females and young males), or the region is yellow to orange. The blue-throated specimens are all adults, but not of maximum size, while the yellow or orange-throated specimens range in snout to vent measurement from 41.5 mm. to a maximum of 54 mm.

A postfemoral dermal pocket is regularly present behind the insertion of the hind limb.

The subspecies has been recorded in Mexico from the states of Sinaloa (Boulenger, 1883) and Sonora (Baird, 1859; Cragin, 1884; Garman, 1887; Van Denburgh, 1922; Allen, 1932).

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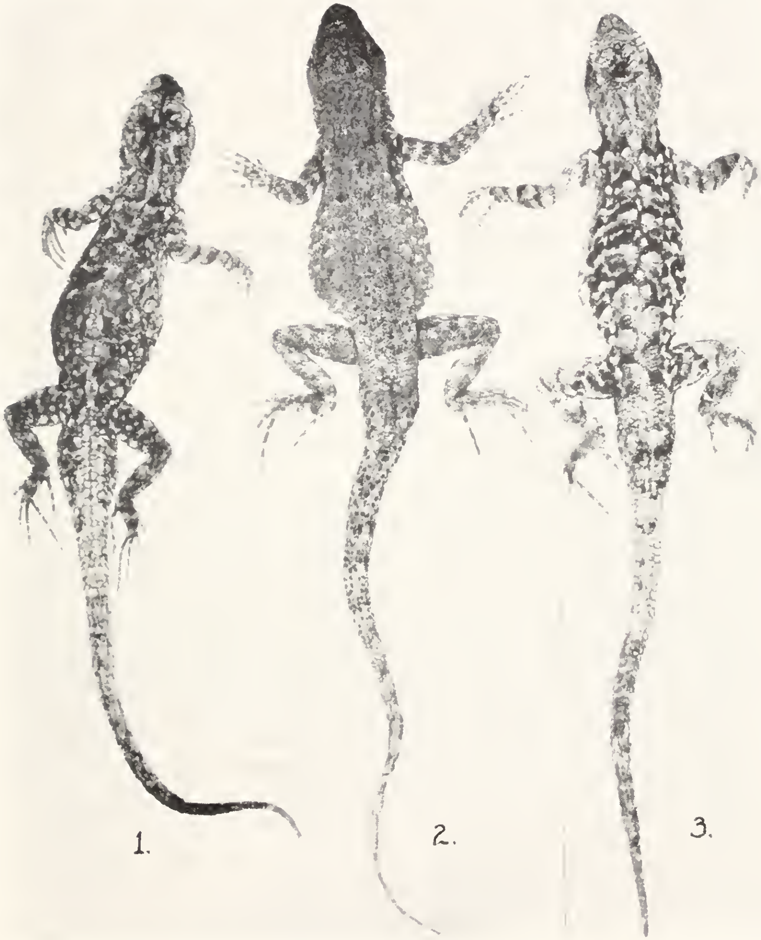
PLATE XXVI

FIG. 1. *Uta tuberculata.* EHT No. 552, male. Actual total length, 103 mm.

FIG. 2. *Uta taylori.* EHT No. 320a, male holotype. Actual total length, 125.7 mm.

FIG. 3. *Uta caerulea.* DHD and HMS No. 132, male holotype. Actual total length, 118 mm.

PLATE XXVI



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Notes on Some Mexican Lizards of the Genus Holbrookia, with the Description of a New Species

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Abstract: The collections studied were secured in Mexico during the summers of 1932 and 1934, by Edward H. Taylor, David H. Dunkle and Hobart M. Smith. The species discussed are *Holbrookia bunkeri* (new species), *H. dickersonae*, *H. maculata approximans*, *H. texana*, *H. elegans elegans* and *H. elegans thermophila*.

The following notes and descriptions are based upon the specimens of the genus Holbrookia in three collections of reptiles and amphibians from Mexico—one secured during the summer of 1932 by Dr. Edward H. Taylor and myself, another during the summer of 1934, by Mr. David H. Dunkle and myself, and the other secured in 1934 by Doctor Taylor. Specimens in the collections are designated by EHT and HMS, DHD and HMS and EHT, respectively.

I wish here to express my appreciation for the aid received, in the collection and study of this material, from Dr. Edward H. Taylor, Mr. David H. Dunkle, Mr. C. D. Bunker and Dr. H. H. Lane. I am further indebted to Mr. J. C. Bay of John Crerar Library for his kindness in loaning necessary reference books. The study has been aided by a grant received from the University of Kansas graduate research fund.

Holbrookia bunkeri, sp. nov.

(Plate XXVIII, fig. 3)

Holotype. Female, DHD and HMS No. 80, collected 15 miles south of Juárez, Chihuahua, Mexico, on June 19, 1934, by David H. Dunkle and Hobart M. Smith.

Diagnosis. A Holbrookia of moderate size; tail longer than body (ratio .545 to the total length); hind leg long (ratio .86 to snout-vent measurement); femoral pores few (10); enlarged supraoculars distinctly separated from frontals by a row of small granules; upper labial border flared; dorsal scales small, flat, larger than lateral granules; series of enlarged lateral granules from axilla to groin separated from ventrals only by one or two rows of smaller scales; ventral scales from gular fold to anus 75; none of the scales on body strongly keeled or mucronate; lateral abdominal blotches two, very small, elongate, distinct, not surrounded by blue.

Description of type. Head rather flattened, outline (viewed from sides) a smooth, even curve from occipital region to snout; scales of frontal, frontoparietal and anterior regions of head subequal in size, smooth, not conspicuously elevated; each scale anterior to frontal with a single posterior pit; median sector of nasal scales divided into three; two scales between nasals; two canthals; six superciliaries; enlarged supraoculars about 15-17 in number, not greatly enlarged nor in distinct rows; a row of granular scales about inner margin of orbit, separating supraoculars from frontals; five keeled suboculars, the median very long, the others much shorter; labial region flared, almost flat; six strongly imbricate and keeled upper labials; width of rostral about equal to distance between outer edges of nares; median third of rostral more or less triangular in shape, its base, as it were, elongated on either side and mostly overlapped by the first labial on either side; lower labials eight or nine to below middle of eye, gradually increasing in size posteriorly to a point below the middle of eye; symphyseal very small, smaller than first lower labial on either side, squarish, followed by a small median triangular scale; anteriorly in lateral gular region a single row of large scales, larger than and in contact with anterior lower labials; these scales decreasing in size posteriorly, and increasing in numbers to about three rows; posterior temporals large, the largest about equal in size to the posterior labials; anterior temporals somewhat smaller; gular scales smaller toward median ventral line; two gular folds, the anterior fold shallow and bordered anteriorly by the small gular scales, which grade into the granular scales which form the fold; posterior gular fold bordered anteriorly by scales as large as the ventrals on body, continuing on either side, slightly anterior to the insertion of the forearm, and terminating low on the shoulder; scales above and behind insertion of foreleg very small, granular, smaller than laterals; scales of trunk gradually increasing in size toward the median dorsal line; scales here about twice size of laterals; laterals in groin, above and behind insertion of hind leg granular; a series of enlarged lateral granules from a point just behind axilla to near groin, narrowly separated from ventrals by two rows of small granules; all scales on body smooth and not mucronate; scales on anterior surface of femur about size of ventrals on abdomen, smooth, decreasing slightly in size toward femoral pores; scales on posterior and dorsal surfaces of femur about equal in size to lateral abdominals, also smooth; dorsals of tibia slightly larger than dorsals on body, smooth; ventrals on tibia somewhat larger than anterior femorals, some on the anterior lateroventral suface weakly keeled; dorsals on foot smooth, ventrals keeled; all scales on forearm smooth except those on ventral surface of hand.

Color above grayish, with a series of about nine very indistinct darker spots, emarginate behind, on each side of median dorsal line to base of tail; tail with about seven narrow transverse darker bands, interrupted medially on base of tail; limbs with very dim bands; numerous light flecks on body and base of tail, a few dark spots on neck; gular region and breast suffused with blackish; abdomen and posterior parts whitish; two small, narrow, diagonal black bars on each side of abdomen.

Snout to vent, 50 mm.; tail, 59 mm. (ratio, tail to total length, .545); hind leg, 43 mm. (ratio, hind leg to snout-vent measurement, .86); foot, 20 mm.; femoral pores, 10-10; ventrals from gular fold to anus, 75.

Relationships. The species is probably most closely related to *H. propinqua,* but differs from this species markedly by the possession of larger dorsals, smooth and rounded scales on the body and limbs, a smaller number of femoral pores, and the almost complete fusion of the lateral row of enlarged granules with the ventrals. In *H. propinqua* the lateral row of enlarged granules is very distinct and separated from the ventrals by six or seven rows of small granules. It differs from *H. maculata* and its subspecies by the possession of smooth, flat scales on the body, a much longer tail and longer hind legs; from *H. elegans* and *H. pulchra* it differs in the presence of very small scales between the frontals and enlarged supraoculars, almost complete absence of keels on the scales of the limbs, more strongly flaring labial and rostral regions, and longer hind legs; from *H. dickersonae* it differs in the absence of blue about the lateral dark spots, much more strongly imbricated upper labials, the strong flaring of the labial and rostral regions, the larger scales on the edge of the gular fold, and the longer tail.

Remarks. The propinqua group of Holbrookia is known from central Texas (*propinqua*) and in Arizona and the northwestern costal region of Mexico (*pulchra* and *elegans*). *Holbrookia bunkeri*, which belongs to this group, occupies a more or less median area in the great hiatus which exists between the respective ranges of the eastern and western species.

Schmidt (1922, p. 714) mentions a specimen from Chihuahua in the U. S. National Museum (No. 58446), remarking that it "may be a juvenile *propinqua*." It is possible that this specimen belongs to the species described here.

A number of eggs are present within the abdomen of the type. The region in which it was collected is low, rather barren, and very sandy. A short distance south of the locality where this specimen was taken there are large numbers of wandering and stationary sand dunes. It is likely that *H. bunkeri* may be more common in this habitat than it was in the adjacent areas.

The species is named for Mr. C. D. Bunker, curator in charge of the Museum of Birds and Mammals of the University of Kansas, who made possible our trip by the loan of complete equipment. I am also indebted to him for the loan of comparative material used in this and other studies of Mexican and United States reptiles and amphibians.

Holbrookia dickersonae Schmidt

Fourteen specimens are in the collections, from the following localities: Durango: Near Avilco, August 25, 1932 (EHT and HMS No. 4384); 5 miles north of Conejos, June 25-26, 1934 (DHD and HMS Nos. 296-297, 318-319); 25 miles north of Bermejillo, June 27, 1934 (DHD and HMS Nos. 328-334, 344). Coahuila: 10 miles east of Torreón, August 20, 1932 (EHT and HMS No. 4384).

The bluish area on the sides of the belly is apparently very constant in the males. The smallest specimen (41 mm., snout to vent) shows more bluish in these patches than any of the males of *H. maculata approximans* in the collections. The dark blotches within the lateral blue area are more frequently two than three; in only one specimen (male) are there three distinct blotches. In two males there is a faint indication of the third (posterior) blotch; in all females there are but two.

Variations in proportions are shown in the following table.

Measurements and scale counts of *Holbrookia dickersonae*

I	Number	4385	296	333	331	318	319	4384
II	Sex	♂	♀	♀	♀	♀	♀	♀
III	Snout to vent	41.0	46.0	50.0	52.0	52.0	52.5	56.0
IV	Tail	.	44.0	49.0	50.0	...	48.0	48.0
V	Total length	...	90.0	99.0	102.0	..	100.5	104.0
VI	Ratio, IV to V	.	48	.49	.49	...	47	.46
VII	Hind leg	33.0	41.0	42.0	44.0	46.0	43.0	40.5
VIII	Ratio, VII to III	.80	.89	84	.84	.88	.81	.72
IX	Ventrals	69	66	82	64	74	67	64
X	Femoral pores	10–10	12–13	11–12	11–12	10–11	11–12	8–9

Measurements and Scale Counts of *Holbrookia dickersonae*—Concluded.

I	Number	330	297	329	328	344	332	334
II	Sex	♂	♂	♀	♂	♂	♂	♂
III	Snout to vent	57.0	57.0	59.0	59.5	60.0	63.5	64.0
IV	Tail	66.0	...	47.0	65.0	66.0	69.0	67.0
V	Total length	123.0	.	106.0	124.5	126.0	132.5	131.0
VI	Ratio, IV to V	.53	...	.44	52	.52	.52	.51
VII	Hind leg	43.0	50.5	42.0	49.0	48.0	51.0	50.0
VIII	Ratio, VII to III	.75	.88	.71	.82	.80	.80	.78
IX	Ventrals	72	76	67	74	72	75	70
X	Femoral pores	10–10	11–12	12–12	11–12	12–13	10–11	11–11

The specimens from Durango were found in open, barren areas, where the lizards could be seen running about at considerable distances. They were extremely wary, running before it was possible to get within rifle shot, unless approached cautiously. The specimen from Coahuila was caught by hand amongst leaves along the side of the road in heavy brush. Five of the six females collected during June contained eggs; there were nine in one specimen (No. 329).

The species has before been reported only from southern Coahuila (Castanuelas and Alamos de Parras; Schmidt, 1922).

Holbrookia maculata approximans (Baird)

Four specimens were collected in 1934 by David H. Dunkle and myself: No. 95, 35 miles south of Moctezuma, Chihuahua, June 20;

Nos. 125-126, 40 miles south of Moctezuma, Chihuahua, June 21; No. 727, La Colorada, Zacatecas, July 8.

The specimen from La Colorada has longer hind legs, more femoral pores and a greater number of ventrals from gular fold to anus than usual, and in these respects approaches *H. dickersonae.* The tail, however, is shorter than in males of the latter species, and the black bars on the sides of the abdomen are not enclosed by blue.

Measurements and scale counts of *Holbrookia maculata approximans*

I	Number	727	126	125	95
II	Sex	♂	♂	♂	♀
III	Snout to vent	51.0	55.0	56.0	57.0
IV	Tail	42.0	53.0	50.0	39.0
V	Total length	93.0	108.0	106.0	96.0
VI	Ratio, IV to V	.45	.49	.47	.40
VII	Hind leg	41.0	41.0	43.5	34.5
VIII	Ratio, VII to III	.80	.74	.77	.75
IX	Ventrals	81	75	66	69
X	Femoral pores	13-15	11-11	9-11	?

Schmidt (1922) records this form from San Luis Potosí (Jesús María), Zacatecas (Berriozábal), Chihuahua (between Ojos del Diable and Rio Santa María), Guanajuato and Durango. The records given by Cope (1887) of *H. maculata* from Guanajuato and Chihuahua are probably of this subspecies; likewise those of Garman (1887) of *H. maculata* from San Luis Potosí and Concordia (Coahuila); and that of Dugès (1896) of *H. approximans* from San Felipe (Guanajuato). Other records are from dubious localities.

Holbrookia texana (Troschel)

Thirty-seven specimens are in the collections, from the following localities: Nuevo León: Near Vallecillo, June 8, 1932 (EHT and HMS No. 269); spring near Sabinas Hidalgo, June 8, 1932 (EHT and HMS Nos. 323-324); 31 miles south of Sabinas Hidalgo, Sept. 1, 1932 (EHT and HMS No. 4622). San Luis Potosí: 30 miles north of Matehuala, August 20, 1932 (EHT and HMS Nos. 4057-4058). Coahuila: 4 miles west of Saltillo, August 23, 1932 (EHT and HMS Nos. 4280-4287); 2-3 miles north of Gomes Farías, August 21, 1932 (EHT and HMS No. 4128); 32 miles west of San

Pedro, August 25, 1932 (EHT and HMS Nos. 4309-4313); 1½ miles west of Saltillo, August 24, 1932 (EHT and HMS Nos. 4423-4427, 4429-4437); near deserted village 30 miles west of La Rosa, August 30, 1932 (EHT and HMS Nos. 4522-4523). Durango: 6 miles northeast of Pedriceña, August 27, 1932 (EHT and HMS No. 4377); 7 miles south of La Loma, August 25, 1932 (EHT and HMS No. 4387); near Pasaje, August 28, 1932 (EHT and HMS No. 4441). Chihuahua: 15 miles south of Moctezuma, June 20, 1934 (DHD and HMS No. 120); Rio San Pedro, between Chihuahua City and Naica, June 22, 1934 (DHD and HMS Nos. 183-186); 18 miles north of Escalon, June 25, 1934 (DHD and HMS Nos. 257-260).

Holbrookia texana has been reported previously from the states of Chihuahua (Cope, 1887, 1900; McLain, 1899; Gadow, 1905), Coahuila (Yarrow, 1883; Garman, 1887; Cope, 1900; Günther, 1890), Nuevo León (Yarrow, 1883; Cope, 1900; Gadow, 1905; Günther, 1890), Durango (Gadow, 1905) and Sonora (Baird, 1859; Günther, 1890; Van Denburgh, 1922).

Holbrookia elegans elegans Bocourt

(Plate XXVII, fig. 2; Plate XXVIII, fig. 5)

Six specimens were secured by Dr. Edward H. Taylor near Presidio de Mazatlán, Sinaloa, Mexico, on July 22, 1934. They were found in a small sandy area in a bend of Rio Mazatlán not far from its mouth. They were extremely wary, running at the first sight of danger, and, unlike *H. elegans thermophila* and other species of Holbrookia, would not stop at a point of vantage to look about in their peculiarly curious manner, but would run directly to cover—under the sand at the bases of the occasional small shrubs which occurred there, or under piles of brush.

On the same trip Taylor secured a large series of *Holbrookia elegans thermophila* (Barbour) from Sonora. These specimens possess a certain few characters which distinguish them readily from the specimens taken at Mazatlán. The differences between these two forms—*H. elegans elegans* and *H. elegans thermophila*—are not great, yet sufficiently recognizable and constant that the two populations should be nomenclatorially recognized.

The specimens from Presidio (topotypes) possess tails shorter than the body in females (.49 to .493 of the total length). The single male has a regenerated tail. In all the females from Sonora, the tails are longer than the body (.507 to .574 in 16 specimens;

only one below .520; in the males the ratio of the tail to the total length varies from .528 to .601.)

The femoral pores of the specimens from Presidio are much larger than in those from Sonora. The pores of the single male of *H. elegans elegans* are about two-thirds as great in diameter as the scales are long; in large males from Sonora the diameter of the pores is not over half the length of the pore scales. In all the females of *H. elegans elegans* the pores are of about the same size as in the males of *H. elegans thermophila* of approximately the same snout-vent measurement, their diameter about one-half the length of the pore scales. On the other hand, even the largest females of *H. elegans thermophila* do not have pores whose diameter is over a fourth of the length of the pore scales.

This very great difference in size of the femoral pores, especially in females, cannot be a difference due to variation in sexual activity, for females of both were collected with eggs in about the same state of development.

Aside from these important structural differences, there are also differences in coloration. Of 35 females of *H. elegans thermophila*, only six show any evidence of the presence of a pink spot in the median posterior part of the gular region; all females (five) of *H. elegans elegans* possess the pink spot. It is present also in the single male of *H. elegans elegans,* but absent in all 33 of the males of the other subspecies. Allen (1933, p. 9) gives the extremes of variation in this character in specimens from Hermosillo; that of the females (34) is 0.52 to 0.66, and of the males (23), 0.55 to 0.60.

The dorsal rows of spots in females of *H. elegans elegans* are much more regular than in *H. elegans thermophila.* It is quite difficult to describe accurately the difference, which, once observed, can be seen to be quite distinctive. The spots in the southern form are more strongly angular, more regularly quadrilateral, and more definitely outlined by dark brown and white than in females of the northern form. In the latter they are usually more U- or V-shaped than quadrilateral, and the broad anterior border of each is only rarely definitely outlined.

There is no apparent difference in the dorsal coloration of the males. As in the larger males of *H. elegans thermophila,* so in the male of *H. elegans elegans* the dorsal spots are broken and obscured by the development over the whole body of numerous small, round, light spots. There is, however, a difference in the lateral black spots. In the male of the southern form the transverse diameter of the spots is over twice the longitudinal diameter (including the part above the lateral fold, about three times), and there is but very little blue surrounding them. In all but one male of *H. e. thermophila* of approximately the same size, the blue completely surrounds the black spots and extends anteriorly and posteriorly from them a distance of from two to four or five millimeters. In these the black spots are only about one-third broader than long, and are more oval than quadrilateral in shape. In younger males the blue is more restricted, in a few cases approaching the condition found in the larger males of *H. elegans elegans;* the black spots are also somewhat broader, but in only three specimens do they approach the shape and proportions of those in *H. elegans elegans.*

A difference in the habits and habitat preferences of the two forms was noted by Doctor Taylor. *H. e. thermophila* was found only in flat, gravelly areas, but never in hills nor in sandy regions, although both of the latter types of habitat were carefully examined. Moreover, the lizards were not very wary, running when one approached too closely, but not to cover. They would run a short distance, and then stop to look around, much as *texana* also does.

H. elegans elegans, on the other hand, was found only in the place mentioned above, and was very abundant but very difficult to collect. It may be inferred that they would be found on the sandy beaches near Mazatlán, in a type of habitat which *thermophila* does not occupy at Guaymas; at least, it was not found by Taylor, who collected extensively on the beaches.

The published records of *H. elegans* which may be considered, on the basis of geographical probability, to be of *H. elegans elegans,* are all from Sinaloa, as follows: Mazatlán (Cope, 1868 [*Holbrookia bischoffi, nomen nudum, fide* Cope, 1887]; Bocourt, 1874; Cope,

Measurements and scale counts of *Holbrookia elegans elegans*

I	Number	643	647	644	646	648	645
II	Sex	♀	♀	♀	♀	♀	♂
III	Snout to vent	54.0	55.0	57.0	61.0	62.0	70.0
IV	Tail	51.5	54.5	....	57.0	61.0	....
V	Total length	105.5	109.5	....	118.0	123.0	....
VI	Foreleg	24.2	25.9	25.5	26.3	28.0	32.3
VII	Hind leg	39.0	41.5	41.0	44.0	45.0	....
VIII	Femoral pores	14–16	14–14	14–15	13–14	13–14	14–?
IX	Scales, gular fold to anus	66	66	70	62	68	67
X	Ratio, IV to V	.488	.493	....	.479	.495	....

1887; Boulenger, 1885; Dugès, 1896; Schmidt, 1922); Rosario and Escuiñapa (Schmidt, 1922). The latter author records *elegans* also from Bacubirito, Sinaloa, but since this locality is possibly within the range of *H. elegans thermophila,* it is problematical to which subspecies the specimens belong. Cope (1887) and Dugès (1896) report the species from Chihuahua, but the records are undoubtedly incorrect; it is quite possible that the specimens which they reported belong to the species *H. dickersonae.*

Holbrookia elegans thermophila (Barbour)

(Plate XXVII, fig. 1; Plate XXVIII, fig. 4)

Sixty-eight specimens of this form were secured by Doctor Taylor during the summer of 1934, in the following localities of the state of Sonora: 53 miles south of Nogales (EHT Nos. 58-59, June 19; 64, June 20); 8 miles south of Magdalina (EHT Nos. 75-77, June 20); near Noria (EHT Nos. 87, 88, 89, 89a, 90, June 21, 22); 30 miles south of Noria (EHT No. 111, June 22); 5 miles southwest of Hermosillo (EHT Nos. 128, 137, June 23; 170, June 22); 54 miles south of Hermosillo (EHT Nos. 192-196, June 26); 10 miles northwest of Guaymas (EHT Nos. 209, 209a, 210, 210a, 211, 211a, June 28; 226-229, June 29; 240-250, June 30; 282, 288, 289, July 1; 299, July 2; 323, July 3; 342-345, 349-353, July 4; 398, July 6; 406, July 7; 409-412, July 8; 467-472, July 12; 1135-1136, 1119a, 1119b, 1119c, 1119d, August 4).

Comparisons of this subspecies with *H. elegans elegans* have been given in the discussion of the latter.

A female from Noria (No. 90) has a very peculiar color pattern. Each of the brown dorsal blotches are completely surrounded by round, light areas which are strongly contrasted against a darker background of blackish suffusion. The proximal portion of the tail (the remainder lost) and the sides of the body are similarly marked, but less distinctly. There are no marked differences in scalation or proportions.

In one male (No. 64) there are three lateral black oblique bars on each side of the body. Two on each side occur in the other males of the series (32).

H. elegans thermophila has been reported in Sonora from Guaymas (Barbour, 1921; Schmidt, 1922; Allen, 1932), San Jose de Guaymas (Barbour, 1921), Batamotal (Schmidt, 1922), Hermosillo, Puerto and Llano (Allen, 1932). Schmidt (1922) mentions specimens from Bacubirito, Sinaloa; it is possible that these are *H. elegans elegans.*

Measurements and scale counts of *Holbrookia elegans thermophila*

FEMALES

I Number	249	228	409	245	76	170	410	210	58	211	344	470	226	250	343
II Snout to vent	51.0	52.0	53.0	53.0	53.0	53.0	53.5	54.0	54.0	54.0	56.0	58.0	60.0	62.5	63.0
III Tail	63.5	66.0	67.5	66.0	59.5	62.0	64.0	73.0	60.0	65.0	73.0	70.0	66.0	80.0	65.0
IV Total length	114.5	118.0	120.5	119.0	112.5	115.0	117.5	127.0	114.0	119.0	129.0	128.0	126.0	142.5	128.5
V Foreleg	25.0	25.2	24.2	25.3	25.5	23.2	23.0	....	25.4	25.0	24.5	26.0	25.0	27.5	28.0
VI Hind leg	43.5	44.0	39.5	45.0	42.5	38.0	42.0	45.5	40.3	43.5	48.5	47.0	45.0	48.0	45.0
VII Femoral pores	12-12	14-15	12-14	12-13	11-11	13-14	13-15	14-16	11-12	13-13	13-14	13-15	14-?	13-14	11-13
VIII Ventrals	72	67	68	74	69	64	70	67	65	73	80	71	74	67	75
IX Ratio, III to IV	.554	559	.560	.554	.528	.539	.544	.574	.526	.546	.558	.546	.523	.561	.507

MALES

I Number	54	243	240	210	342	128	137	77	87	246	289	467	211	209	1119c
II Snout to vent	57.0	58.0	59.0	60.0	60.5	61.0	62.0	62.5	62.5	64.0	65.0	68.0	71.0	72.0	75.0
III Tail	73.0	66.0	89.0	....	81.0	77.0	76.5	70.0	90.0	88.0	77.0	92.0	91.0	106.0	93.5
IV Total length	130.0	124.0	148.0	....	141.5	138.0	138.5	132.5	152.5	152.0	142.0	160.0	162.0	178.0	168.6
V Foreleg	29.5	26.0	29.1	27.5	28.0	27.0	29.5	26.0	28.3	30.0	31.0	31.0	34.0	33.0	34.0
VI Hind leg	49.0	44.0	49.0	50.0	51.0	45.2	49.0	47.5	44.0	51.5	51.0	55.0	56.0	58.0	60.0
VII Femoral pores	11-12	13-?	14-15	16-16	15-15	10-11	14-14	12-12	13-?	12-13	12-13	13-14	10-10	12-14	13-15
VIII Ventrals	71	69	75	79	68	63	71	77	75	69	80	72	73	73	76
IX Ratio, III to IV	.554	.532	.601	....	.572	.557	.552	528	.590	.578	.542	.571	.561	.595	554

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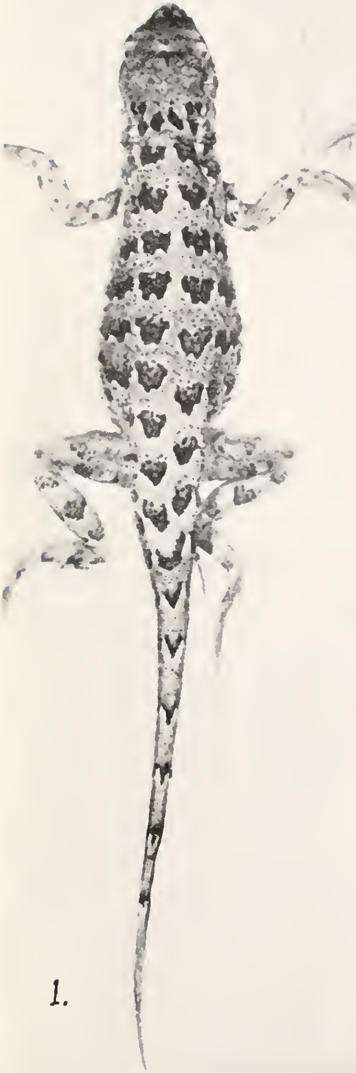
PLATE XXVII

FIG. 1. *Holbrookia elegans thermophila.* EHT No. 410, female, snout to vent measurement 54.5 mm.

FIG. 2. *Holbrookia elegans elegans.* EHT No. 648, female, snout to vent measurement 62 mm.

PLATE XXVII



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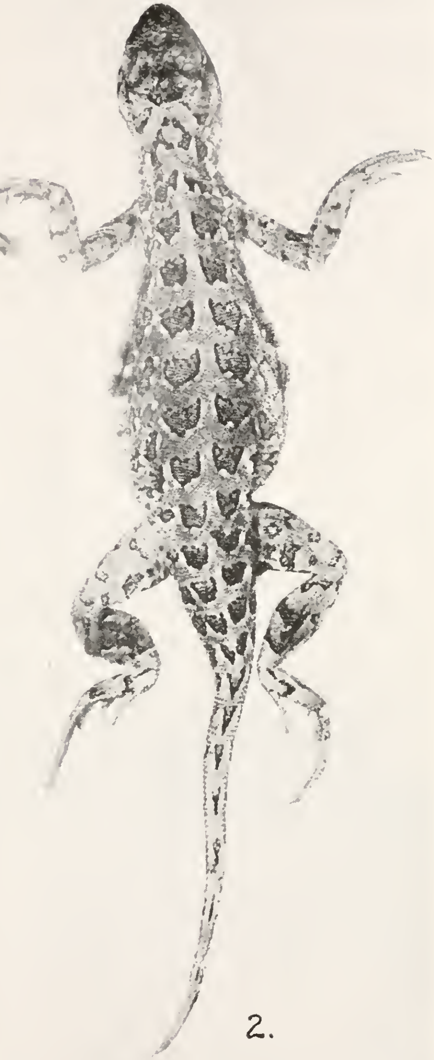

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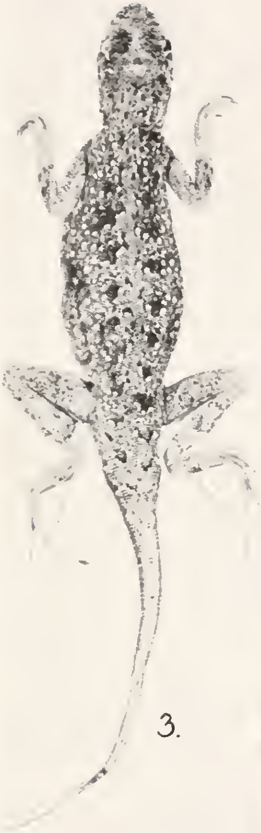
PLATE XXVIII

FIG. 3. *Holbrookia bunkeri.* Type, female, snout to vent measurement 50 mm.

FIG. 4. *Holbrookia elegans thermophila.* Same as in fig. 2. Ventral sacral region.

FIG. 5. *Holbrookia elegans elegans.* Same as in fig. 1. Ventral sacral region.

PLATE XXVIII



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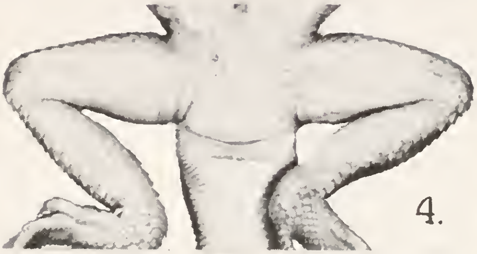

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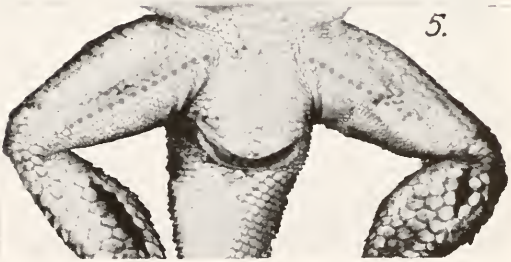

5.

THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXII.] APRIL 15, 1935 [NO. 9.

Coleonyx fasciatus, a Neglected Species of Gecko

By EDWARD H. TAYLOR

IN THE first volume of the catalogue of the lizards in the British Museum, published in 1885, Boulenger described as new a specimen of a gecko which he named *Eublepharis fasciatus*. This specimen was collected by Forrer in Ventanas, Durango, Mexico. The description is brief and probably because of this brevity and resultant lack of distinguishing characters, Stejneger (North American Fauna No. 7, 1893, p. 163) placed the species in the synonymy of *Coleonyx variegatus* (Baird).

Günther (Biol. Cent. Amer., April, 1893, p. 83, pl. 31., fig. A) gives a somewhat better description, together with a good figure of the entire animal, and an enlarged drawing of the head. This latter paper apparently was not seen by Stejneger prior to his synonymizing the two forms.

Van Denburgh (1923) likewise follows Stejneger in placing this form in the synonymy of *C. variegatus*.

In the summer of 1934, at a locality about 15 miles south of Presidio, Sinaloa, Mexico, I collected a male specimen of what appeared to be Boulenger's species. However, to make certain its identity, I sent the specimen to Mr. H. W. Parker of the British Museum, who compared it with the type. He states: "I have compared it with Boulenger's type of *C. fasciatus* and have no hesitation in saying that the two are conspecific. I do not think there can be any question that the type, far from being a juvenile *C. brevis,* is a full-grown female of a distinct species."

Since only this single other specimen (the type) is known, and the descriptions of this brief, I offer the following data on the specimen in my collection (No. 556).

A medium-sized species decorated above with broad black quadrangular blotches separated by narrower cream-white bars which are for the most part confluent with the ventral coloration. Covered above with more or less uniform, minute scales lacking all admixture of tubercles. Labials immaculate; a well-defined white stripe following the canthus from eye to near upper edge of rostral; head uniformly gray-black; upper and lower eyelids cream-white; anal spur subconical, directed backward and upwards, about .88 mm. in length.

Tail covered with flat, smooth, imbricating scales, the annuli scarcely distinguishable, and lacking all tubercular scales. Femoral pores 11, in a broadly angular series; ventral scales larger and imbricating, in about 38 rows; 18 lamellae under fourth toe; six or seven upper labials, and an equal number of lower labials; granules on snout much larger than those on top of head, rostral high, bordered posteriorly by a pair of supranasals which form a very narrow median suture and which separate the rostral from the nasal; a second pair of supranasals border the first pair, and are separated by three small scales.

When compared with its congener, *C. variegatus* (specimen of equal length), from the adjoining state of Sonora, the following differences are in evidence: Rostral larger; nostrils a little more widely separated; suture of the anterior supranasals a half shorter; scales on snout and lores nearly twice as large; head longer, somewhat slenderer, with larger eyes; ear opening nearly twice as large; chin scales bordering mental and lower labial distinctly larger; terminal lamellae on digits, lateral to claw, larger; the lamellae under digits heavier; the whole of foot and hand larger, more robust; scales around the tail nearly or more than twice as large and averaging (10) less in number.

It differs also in having a white stripe from eye to rostral along the canthal region, immaculate labials, and in having the top of head unicolor.

The specimen was obtained late in the afternoon ensconced beneath a pile of small logs in the forest, June 19, 1934. Here the trees (really only overgrown shrubs, usually about 15 to 20 feet high) were thick, and beginning to leaf out, since the rains had begun just a short time previously. Collecting in this locality terminated shortly after the specimen was found, and plans to return there from my station at Mazatlán failed to materialize.

The fauna in this region about Mazatlán and Presidio is quite different from that near Guaymas, which lies on the coast 250 km. to the north. My herpetological collections in the surroundings of the two localities show the following:

	Snakes.	Lizards.	Amphibians.	Chelonia.
Guaymas, species taken.......	15	17	5	2
Mazatlán, species taken.......	7	13	13	1
Species in common to the two localities	2	2	1	1

While the above data proves nothing accurately as to the quantitative differences in the fauna, it makes obvious, however, that the fauna is quite different in the two localities, and it is unlikely that the northern form of the genus *Coleonyx* (*C. variegatus*) occurs at Mazatlán.

THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXII.] APRIL 15, 1935 [No. 10.

Arkansas Amphibians and Reptiles in the Kansas University Museum

EDWARD H. TAYLOR

DURING the past ten years the University of Kansas Museum has accumulated a large collection of amphibians and reptiles from Arkansas. As the locality records are important in determining limits of distribution, this data is incorporated with the following notes.

The first considerable contribution to this collection was made during the summer of 1926, when I accompanied Theodore E. White, then a student in the University of Kansas, to Devall Bluff, Prairie county, for the purpose of making a representative herpetological collection from this region. June 24 to July 13 was spent in this region, although Mr. White made a trip to Lewisville during the first part of July.

Prairie county lies in the eastern third of the state, somewhat below a line dividing the state into northern and southern halves. It is in the hills on the edge of the valley of the White river. In the vicinity of the town there are numerous oxbow lakes, ponds and bayous. West of the town there are low hills, the country being partly wooded and partly cultivated.

The second part of the collection was obtained from Mr. R. E. McEntyre. This was made during the spring and summer of 1926, chiefly about Lewisville, Lafayette county. The third part was obtained from Byron Marshall, from Imboden, Lawrence county, in the northern part of the state.

This paper does not attempt any complete list of the fauna, but gives records only of specimens in the Kansas Museum collections. The numbers listed are those of this museum.

CAUDATA

Amphiuma tridactylum Cuvier. Two specimens (Nos. 3862 and 3863) from Lewisville, Lafayette county, are in the collection, collected by R. E. McEntyre.

Ambystoma jeffersonianum (Green). Localities: Crawford Co., No. 4600, R. E. McEntyre, Nov. 5, 1926; Lafayette Co., near Lewisville, No. 4630, T. E. White, July 5, 1926.

Ambystoma maculatum (Shaw). Locality: Lafayette Co., near Lewisville, Nos. 2625-2626, May 20, 1926; Nos. 7194-7195 (skeletons), March 5, 1926; Nos. 4017-4022, Feb. 26, 1926; Nos. 4023-4024, Mar. 5, 1926; Nos. 4025-4028, Apr. 6, 1926. All collected by R. E. McEntyre.

Ambystoma texanum (Matthes). Locality: Lafayette Co., near Lewisville, Nos. 2634-2638, 4932-44, 4145-4174, Mar. 5, 1926; Nos. 4046-4079, 4122-4144, 4556-4557, Apr. 6, 1926; Nos. 4080-4106, 4181-4232, 4175-4180, Apr. 1, 1926; Nos. 4101-4121, Feb. 26, 1926; Nos. 7192, 7193, 9191 (skeletons). All collected by R. E. McEntyre.

Ambystoma opacum (Gravenhorst). Locality: Lafayette Co., near Lewisville, No. 1948, Jan. 12, 1926; No. 1970, Feb. 14, 1926; Nos. 3931-3942, 4011-4012, Feb. 26, 1926; Nos. 3966-3985, Mar. 5, 1926; Nos. 3943-3965, Apr. 1, 1926; Nos. 3986-4010, 4045, Apr. 6, 1926; Nos. 7187-7191 (skeletons), Mar. 5, 1926. All collected by R. E. McEntyre.

Manculus quadrigitatus quadridigitatus (Holbrook). Lafayette Co., near Lewisville, Nos. 2646, 5007-5026, 11607-16663, Aug. 20, 1926; No. 5004, May 20, 1926, collected by R. E. McEntyre; Nos. 16928-17015, July 5, 1926, T. E. White.

Eurycea melanopleura (Cope). Two specimens (Nos. 14775-14776) were collected near Lewisville, Lafayette Co., by R. E. McEntyre.

Eurycea lucifuga Rafinesque. Four specimens were collected by J. D. Black of northwestern Arkansas; No. 17500, 2 mi. east of Alabam, Madison county; and Nos. 18023-18025, 6 miles west of Paririe Grove, Washington county.

Desmognathus brimleyorum Stejneger. Localities: Garland Co., Nos. 4628-4629, J. Hurter, Apr. 9, 1906; Crawford Co., Nos. 4601-4604, R. E. McEntyre, Nov. 5, 1926; Lafayette Co., near Lewisville, Nos. 2627-2633, July 3, 1926, T. E. White; Nos. 2645, Apr. 19, 1926, Jarrel Jackson; Nos. 4558-4563, Mar. 20, 1926, R. E. McEntyre; Nos. 4564-4571, 4605-4627, July 15, 1926, T. E. White; Nos. 4572-4598, Apr. 20, 1926, Jarrel Jackson; Nos. 4631-4647, R. E. McEntyre, Aug. 20, 1926.

Typhlotriton spelaeus Stejneger. A single larval specimen (No. 16191) is in the collection from Imboden, Lawrence Co., collected by

Byron Marshall, Feb., 1930; Nos. 18426-18439, Washington Co., J. D. Black; No. 17247, White Co., E. Cypert; Nos. 14777-14778, Stone Co., Byron Marshall.

SALIENTIA

Scaphiopus holbrooki holbrooki (Harlan). Three specimens were obtained from Imboden, Arkansas (Nos. 9444, 9445 and 1760). Collected by Byron Marshall.

Bufo woodhousii fowleri (Hinckley). This species was found to be especially abundant along the White river in the vicinity of Devall Bluff, where Theodore White and I collected a large series at dusk along the sandy river bank. Localities: Prairie Co., Devall Bluff, Nos. 6190-6280; Washington Co., Nos. 17362-17365, J. D. Black.

Acris gryllus (Le Conte). This form was omnipresent about the ponds and lakes near Devall Bluff. Prairie Co., Devall Bluff, Nos. 6190-6219, White and Taylor; Lafayette Co., Nos. 13544-13569 and 18474, R. E. McEntyre, collector.

Pseudacris feriarum (Baird). A small series (Nos. 11690-11698) was received from Lafayette Co., collected by R. E. McEntyre.

Pseudacris occidentalis (Baird and Girard). The collection contains Nos. 11699-11701, from Lewisville, Lafayette Co., collected by R. E. McEntyre; and No. 17679, White Co.

Hyla cinerea cinerea (Schneider). On the night of July 6 a great chorus of this species was heard at the upper end of Upshaw Lake near Devall Bluff. The night was cloudy and there was a threat of rain after several weeks of dry weather. The frogs were found along the shore of the lake and in the willows that bordered the lake. A large series was taken, all of which were males. The following day a heavy rain fell, and the same night the chorus was even more vociferous than the preceding night. This night I found a few females. These were clasped by males, but I found no evidence of egg deposition. Locality: Prairie Co., Devall Bluff, Nos. 10435-10559, Taylor and White, collectors, June 6 and 7, 1926.

Hyla versicolor versicolor (Le Conte). The series of specimens obtained at Devall Bluff approach the typical form more closely than the related subspecies. Prairie Co., Devall Bluff, Nos. 10702-107, White and Taylor; Lafayette Co., No. 10720; Washington Co., J. D. Black.

Hyla versicolor chrysoscelis (Cope). Six specimens were collected in Lafayette Co. by Mr. White, which apparently approach this subspecies more closely than the typical form (Nos. 10720-10725, July, 1926).

Rana areolata Baird and Girard. Only a single specimen (No. 9278) is in the collection. This was collected at Lewisville, Lafayette Co., by R. E. McEntyre.

Rana catesbeiana Shaw. A series (Nos. 9171-9177 and 9262-9273) was collected at Devall Bluff in July, 1926.

Rana clamitans Latreille. A large series was obtained at Devall Bluff along the edges of ponds and lakes at night. These were more wary than the large bullfrog. Localities: Prairie Co., Devall Bluff, Nos. 9299-9305, 9314-9382, White and Taylor; Lafayette Co., near Lewisville, Nos. 8646-8657, R. E. McEntyre, Aug. 20, 1926; Washington Co., Nos. 16805-17358, June 4, 1932, and Nos. 17735-17736, Aug. 18, 1933, J. D. Black.

Rana pipiens Schreber. Localities: Prairie Co., Devall Bluff, Nos. 9702-9713, July, 1926, White and Taylor; Washington Co., No. 16542, John Davis; Nos. 16443-16444, July, 1932, J. D. Black.

Rana sphenocephala Cope. A single adult species collected in the woods at some distance from the water has been assigned to this species (No. 16109, Prairie Co., near Devall Bluff. Taylor, collector), also a series, Nos. 16110-16113, Lafayette Co., collected by McEntyre.

Rana sylvatica Le Conte. This species is known from only a single specimen (No. 16526) collected by J. D. Black, July 12, 1932, in Washington Co.

Gastrophryne carolinensis (Holbrook). The collection contains the following: Priaire Co., Devall Bluff, Nos. 9922-9937, Taylor-White; White Co., Nos. 17515-17519, Eugene Cypert.

SAURIA

Anolis carolinensis Voigt. Three specimens are in the collection: "South Arkansas," Nos. 4-5, R. L. Moodie, Apr. 1, 1915; Lafayette Co., near Lewisville, No. 16726, T. E. White, July 10, 1926.

Sceloporus undulatus Latreille. Specimens are in the collection from the following localities: Lafayette Co., near Lewisville, Nos. 7228, 12662-12680, 15323-15350, R. E. McEntyre; No. 15322, T. E. White; Pulaski Co., Nos. 10863-10865, Wayne Whitlow; Crawford Co., Nos. 12659-12660, Mark Hanna; Washington Co., Nos. 16854-16873, J. D. Black.

Cnemidophorus sexlineatus (Linné). A good series of this widespread species was obtained at the edge of a small cotton field near Devall Bluff. The lizards did not appear above ground, usually, until about eleven o'clock in the morning (July), at which time they began their feeding activities. After about three o'clock in the afternoon, they ceased activity and disappeared into their burrows. Some of the burrows were opened. It was observed that two, sometimes three or four tunnels would meet at a somewhat enlarged cavity placed usually eight to ten centimeters below the surface of the ground. None examined reached a depth of more than fourteen centimeters. Specimens are in the collection from the following localities: Prairie Co., Devall Bluff, Nos. 3472, 12696-12736, 12760-12764, Taylor and White; Jefferson Co., No. 12737, Hodgeland; Lafayette Co., near Lewisville, Nos. 12778-12781, R. E. McEntyre; Washington Co., Nos. 16714-16732, J. D. Black.

Leiolopisma laterale (Say). This species was observed frequently in the wooded upland near the town of Devall Bluff. None were seen in the lowland that was subject to overflow. Two eggs were obtained from dry, rotting wood July 5, 1926. The embryos were developed to a point where the color pattern was beginning to show. The collection contains the following specimens: Prairie Co., Devall Bluff, Nos. 8815-8819, E. H. Taylor; Lafayette Co., near Lewisville, Nos. 8235, 8243, 8700-8701, 8820-8839, T. E. White and R. E. McEntyre; Pulaski Co., Nos. 8250, 8251, W. B. Whitlow; Crawford Co., No. 7743, R. E. McEntyre.

Eumeces anthracinus Baird. A few specimens of this species were collected in southern Arkansas by R. E. McEntyre, and a splendid series was obtained at Imboden by Byron Marshall. The following numbers are in the collection: Lafayette Co., near Lewisville, Nos. 8803-8808, R. E. McEntyre; Lawrence Co., near Imboden, Nos. 8219-8231, 8840, 8952-8953, Byron Marshall.

Eumeces fasciatus (Linné). I collected a number of these skinks in the woods along the river, as well as in the uplands about Devall Bluff. Several sets of eggs were obtained, usually from under the heavy bark of decaying logs. Invariably the eggs were being brooded. The first set of nine eggs was found July 2, partially incubated. The second, July 13, a set of ten eggs. These were distinctly larger than the preceding set. The young in the eggs were apparently ready to hatch, as the color pattern was complete, and could crawl about when taken from the egg. The specimens seen seemed to be terrestrial, not one being observed in trees or on their trunks. The larger species, *laticeps*, was said to be present, but I failed to discover them. The following specimens are in the collection: Lafayette Co., near Lewisville, Nos. 7759, 7761, 8704, 8706, 8708, 8709, 8844-8849, 8888-8809, 8969-8974, Farrel, Jackson, R. E. McEntyre, and T. E. White; Lawrence Co., Imboden, Nos. 8279-8355, 8864-8873, 8909-8934, 11350-11380, 9127-9129, Byron Marshall; Prairie Co., Devall Bluff, Nos. 8852-8863, Taylor and White.

Eumeces laticeps (Schneider). A series of five specimens, Nos. 7802-7806, of this large skink was obtained from Byron Marshall at Imboden. One specimen, shipped alive to Lawrence, Kan., devoured a specimen of *Eumeces fasciatus* which had been shipped in the same container.

SERPENTES

Carphophis amoena vermis (Kennicott). Washington Co., Nos. 16670, 16671, 16675, June 13-18, 1932; J. D. Black.

Farancia abacura (Holbrook). R. E. McEntyre obtained a single specimen at Lewisville, Apr. 6, 1926 (No. 2211).

Heterodon contortrix (Linné). Two specimens were collected at Lewisville, by R. E. McEntyre; No. 2490, May 15, 1926, and No. 2494, July 7, 1925.

Opheodrys aestivus (Linné). J. D. Black collected a small series of this species in Washington Co.: No. 16557, June 17, 1932; No. 16750, June 29, 1932; No. 16751, July 24, 1932; No. 16752, Aug. 6, 1932; No. 16753, Sept. 12, 1932; No. 18014, Aug. 20, 1933 (Ray McKinzie).

Coluber constrictor constrictor (Linné). Five specimens are in the collection: Lafayette Co., Lewisville, No. 2212, Apr. 6, 1926, and No. 2483, May 15, 1926, McEntyre; Washington Co., No. 15693, Dec. 22, 1931, Hugh Phillips; Lawrence Co., Imboden, No. 17154, Aug., 1929, and No. 17723, May, 1929, Byron C. Marshall.

Coluber constrictor flaviventris (Say). Typical specimens of *flaviventris* appear to be confined to the northwestern part of the state. Washington Co., No. 16673, June 17, 1932; No. 16816, July 7, 1932; No. 16817, July 15, 1932, J. D. Black; Nos. 17927, 17929-17931, Aug. 18-24, E. Davis; Benton Co., No. 18000, Oct. 20, 1933, R. D. Harding.

Masticophis flagellum flagellum (Shaw). J. D. Black collected two specimens of this snake: No. 16900, Oct. 1, 1932, in Washington Co., and No. 17499, June 11, 1933, Madison county.

Elaphe laeta (Baird and Girard). A single specimen, No. 18350, was collected in Washington county, Aug. 6, 1932, by E. Davis.

Elaphe obsoleta obsoleta (Say). Typical specimens of this subspecies were obtained in northwestern Arkansas by J. D. Black and R. D. Harding. Washington Co., No. 16804, Sept. 11, 1932; No. 16905, July 12, 1932, Black; Benton Co., No. 17738, Oct. 20, 1933, Harding.

Elaphe obsoleta confinis Baird and Girard. I collected a single specimen of this species at Devall Bluff (No. 3845) June 23, 1926.

Lampropeltis calligaster (Harlan). A single specimen (No. 7423) collected at Lewisville, Lafayette Co., by McEntyre, May 15, 1926, is in the collection.

Lampropeltis getulus holbrooki Stejneger. Three specimens were collected at Devall Bluff. One specimen was surprised in an old cypress stump, rooting turtle eggs out of a burrow in the rotting wood. Two eggs had already been eaten, and two others had been brought to light. I could not determine the species of the turtle eggs since the embryos were too small to make such a determination. Prairie Co., Devall Bluff, No. 2502, July 1, 1926; No. 3844, June 23, 1926; No. 7432, July 6, 1926, White and Taylor; Crawford Co., No. 2998, Nov. 5, 1926, R. E. McEntyre; Lafayette Co., Lewisville, No. 2491, Apr. 6, 1926, R. E. McEntyre; No. 2501, T. E. White, July 5, 1926; Washington Co., No. 16711, June 15, 1932, J. D. Black.

Natrix erythrogaster erythrogaster (Forster). A series was obtained from Byron Marshall, Imboden, Lawrence county, as follows: Nos. 8359-8369, 11807-11819 (adult with young), 13667-13673, 13684-13686.

Natrix erythrogaster transversa (Hallowell). J. D. Black obtained a single specimen of this species in Washington Co. (No. 16803, June 27, 1932). R. E. McEntyre and T. E. White obtained three specimens, Nos. 2487, 2488, 2895, at Lewisville, Lafayette county.

Natrix rhombifera (Hallowell). This species was found to be common in the region of Devall Bluff. They were captured at night, usually in the edge of the water in rivers and ponds, occasionally in low shrubs lining the water's edge. The following were taken July 2-8, 1926: Nos. 2511, 2512-2516, 2539, 2541-2548, 3588, White and Taylor. A single specimen was collected by R. E. McEntyre at Lewisville, Lafayette Co. (No. 2486).

Natrix sipedon sipedon (Linné). Two specimens, Nos. 2994-2995, were collected by R. E. McEntyre, Nov. 5, 1926, in Crawford Co. Two, Nos. 13705-13706, were collected at Imboden, Lawrence Co., June, 1930, by Byron Marshall.

Natrix fasciata confluens (Blanchard). This species was common in the region about Devall Bluff. They were taken at night in low trees and shrubs along the edge of the ponds and bayous. Nos. 2415 2503-2510, 2538, 3856-3861, Devall Bluff, White and Taylor; No. 2493, May 1, 1926, Lafayette Co., McEntyre.

Storeria dekayi (Holbrook). The following specimens are in the collection: Crawford Co., No. 1734, Dec. 2, 1910, G. D. Hanna; Lafayette Co., Lewisville, No. 2489, Mar. 5, 1926, R. E. McEntyre; Washington Co., Nos. 16600-16601, July 13, Aug. 13, 1932, J. D. Black.

Storeria occipito—maculata (Storer). One specimen was collected in Pulaski Co. by W. B. Whitlow, Sept., 1924 (No. 2492).

Virginia valeriae elegans Kennicott. A single specimen, collected by Byron Marshall at Imboden, Lawrence Co., is in the collection (No. 17454).

Thamnophis sauritus proximus (Say). The following specimens of this widely distributed form are in the collection: Lafayette Co., Lewisville, No. 2366, May 1, 1926, No. 2496, Aug. 20, 1924, No. 2497, Nov. 5, 1926, McEntyre; Crawford Co., No. 2996, McEntyre; Washington Co., No. 15696, Dec. 24, 1931; No. 16599, Aug. 9, 1933, Black.

Thamnophis sirtalis parietalis (Say). J. D. Black has collected this species in the northwestern part of the state. Washington Co., No. 16841, June 18; No. 16880, June 7; No. 16881, July 15; No. 16888, July 23, 1932, Black.

Agkistrodon mokasen Beauvois. Three specimens are in the collection; Lafayette Co., Lewisville, No. 2483; Washington Co., No. 16518, June 3, 1932, John Davis; Benton Co., No. 18130, Oct. 20, 1933, R. D. Harding.

Agkistrodon piscivorus (Lacépède). This species was extremely common about the lakes and ponds in the vicinity of Devall Bluff. A large series was taken, all save one having been captured at night around the edges of the lakes and ponds where they were feeding. When approached with a light they usually remained motionless. Often one would open its mouth widely. Rarely did they attempt to escape by swimming to deeper water.

Several of the live snakes were placed in a box containing live

Pseudemys elegans. Certain of the turtles were bitten by the snakes and eight died within 24 hours, presumably as the result of the bites. In a box containing no snakes there were no deaths among the turtles. Frequent references in literature tell of this snake crawling into bushes above the water during the day. My experience was that none were seen in bushes. In daylight, early one morning, I observed one swimming near the shore, and one was routed and captured from a pile of drift. All the others were found at night, suggesting that the snake is almost exclusively nocturnal in habits. The collection contains the following Arkansas specimens: Lafayette Co., Lewisville, Nos. 2484-2485, Apr. 20, 1926; Nos. 7503-7507, skeletons, Apr. 6, 1926; No. 16140, May 15, 1926, R. E. McEntyre; Prairie Co., Deval Bluff, Nos. 2513-15, 2518-2537, 3846-3854, 7508-7510, June 26-July 5, 1926, Taylor and White.

Sistrurus miliarius (Linné). J. D. Black collected a single specimen, Aug. 22, 1932, in Washington county (No. 16553).

TESTUDINATA

Sternotherus carinatus (Gray). Two specimens of this species were collected from the edge of a pond near Devall Bluff. These apparently were lost, as they were not catalogued in the Museum. A single specimen, No. 3052, was collected by R. E. McEntyre, near Lewisville, Lafayette county.

Sternotherus odoratus (Latreille). Five specimens of this species were found in a pond near Devall Bluff; and two were collected in woods at some distance from the pond. These are Nos. 3390-3393, 3397-3399, and 3477, June 29 to July 7, 1926, Taylor and White.

Kinosternon subrubrum hippocrepis (Gray). The collection contains the following: Prairie Co., Devall Bluff, Nos. 3033, 3394, White and Taylor, June 20 to July 7, 1926; Lafayette Co., Lewisville, Nos. 3053-3055, 3190, R. E. McEntyre.

Macrochelys temminckii (Troost). A number of specimens were collected by seining in the river near Devall Bluff. Numbers of dead specimens, killed by fishermen, were to be seen along the river banks. Prairie Co., Devall Bluff, Nos. 2880, 2882, 3389, 3401, 3402, 3772-3447, White and Taylor; Nos. 2883, 2943, W. D. Warfield; Lafayette Co., near Lewisville, Nos. 3058, 3117, R. E. McEntyre.

Chelydra serpentina (Linné). The following are in the collection: Prairie Co., Devall Bluff, Nos. 2823, 3388, 3775-3779, White and Taylor.

Terrapene triunguis Agassiz. Two specimens were found on the higher land four miles west of Devall Bluff. The following are present in the collection: Lafayette Co., near Lewisville, Nos. 2540, 2855, T. E. White; Prairie Co., Devall Bluff, Nos. 3395-3396, White and Taylor; Washington Co., Nos. 16690, 16874, 17368, 18307, 18334, 18338, 18353-18355, J. D. Black.

Terrapene carolina (Linné). One specimen was collected on a disused road, six miles west of Devall Bluff. Apparently this specimen has been lost as I do not find it in the collection of Kansas University.

Pseudemys elegans (Wied.) Several living specimens of this form and several practically complete skeltons were obtained near Devall Bluff, on the top of a small hill in the woods, about 400 yards from the nearest pond. The summit of the hill, which was probably 175 feet above the level of the ponds, had been chosen by these turtles as an incubating ground and they had gone there for the purpose of depositing their eggs. Several were observed while in the process of digging the holes in the ground and several sets of eggs were found, although none of the turtles was observed depositing eggs. The method of making the holes was as follows: When a female had chosen a spot for making a hole, she would begin scratching the ground with her hind feet. Since the ground at this season was hard and baked, she would urinate on the ground to soften the dirt. Then digging would be resumed. I was unable to watch the process of digging the hole to completion. In one case a female was found approaching a small hole apparently begun the previous day. After feeling about with her hind feet for a time, she urinated and then in a minute or two resumed her digging. I did not observe the deposition of the eggs, but several sets were found buried in small pockets. The dirt, wet when plastered over the openings, was baked very hard on the surface, evidently offering considerable resistance to animals bent upon robbing the nests.

One nest, containing six eggs, showed an excavation 11.4 cm. deep and about 5.6 cm. in greatest diameter; the surface opening was somewhat less than 4 cm. in diameter. The six eggs in this clutch were flesh-white in color, and of a leathery texture. The following are their measurements (in millimeters): 39 x 23; 38 x 22.5; 38.2 x 23; 38.5 x 22.1; 39 x 23; 38.2 x 22.4. A second set obtained nearby have the following measurements: 38 x 23.8; 39.2 x 22; 39.8 x 21.8; 37 x 21; 38 x 22; 38 x 21.8. These eggs were fresh, showing little or no incubation.

More than 15 skeletons were found in the immediate vicinity and two or three specimens that had recently died. I am unable to account for the very high mortality. The carcasses were examined, and they proved to be females with the eggs unlaid. The viscera were in an advanced state of decay, so nothing as to cause could be determined by the examination.

A nest was found which had been opened by some animal, and the leathery shells, emptied of their contents, were scattered about.

A number of other specimens of both sexes were obtained while seining.

The following numbers are in the collection from Devall Bluff: Nos. 1174, 1180, 1371, 1373, 2677-2689, 2749, 2812-16, 2827-2829, 2900, 3109, 3228, 3255, 3558, 3370, 3428-3444, 3447-3448, 3784-3793, White and Taylor, June 20 to July 7, 1926.

Graptemys geographica (Le Sueur). Prairie Co., Devall Bluff, No. 2832, White and Taylor; Lafayette Co., near Lewisville, No. 3795, R. E. McEntyre.

Graptemps pseudogeographica pseudogeographica (Gray). The following specimens were captured by seining in the White river at Deval Bluff: Nos. 1175, 1181, 1183, 1372, 1871, 2463, 2464, 2667-2673, 2750, 2804-2811, 3107-3112, 3232-3240, 3254, 3340-3345, 3359, 3560, 3371-3380, 3386-3387, 3403-3425, 3744, 3781, 3782, 3796, 3802, 3803-3826, White and Taylor, June 20 and July 6, 1926.

Chrysemys picta dorsalis (Agassiz). A single specimen (No. 3783) was collected at Devall Bluff by T. E. White.

Pseudemys texana Baur. The following specimens are in the collection: Prairie Co., Devall Bluff, Nos. 1176-1179, 1182-1185, 2800, 2830-2831, 3113, 3229-3231, 3352-3357, 3364-3369, 3794, Taylor, White, and McEntyre, June and July, 1926; Lafayette Co., Lewisville, No. 2221, R. E. McEntyre, June, 1926.

Deirochelys reticularia (Latreille). A single specimen (No. 3400) was collected at Devall Bluff, by Taylor and White, July 1, 1926.

Amyda spinifera (LeSueur). Splendid series of both sexes of this turtle were taken, which showed an extraordinary amount of sexual difference. The adult females were much larger, usually more than double the measurements of the males, and often three times the bulk of the largest and oldest males.

On a sand bank on the edge of Burnt Bayao, a number of sets of eggs belonging, apparently, to this species were found. The nests were discovered by punching stakes in the sand. None of the clutches obtained were complete, but the numbers of eggs in them varied between 12 and 23. The eggs were nearly round, and covered with a hard (but rather fragile) shell. Some were apparently freshly laid while others showed embryos considerably advanced in development.

The following specimens are in the collection: Prairie Co., Devall Bluff, Nos. 1867, 1869, 1879, 1931, 1949, 1950-1951, 2280-2291, 2357-2666, White and Taylor, June 20, July 6, 1926; Lafayette Co., Lewisville, Nos. 2225-2230, 2761-2762, 2826, 2842, 2930-2990, 3056, R. E. McEntyre.

Amyda mutica (Le Sueur). Large series of both sexes were obtained at Devall Bluff, and the same sex differences noted in *Amyda spinifera,* likewise obtained in this species. It is not improbable that some of the eggs obtained at Burnt Bayao belonged to this species. Prairie Co., Devall Bluff, Nos. 1867-1870, 1874-1876, 1878, 1881, 1930, 1957-1963, 2294-2306, 2308, 2309, 2838-2841, 2999, 3002, White and Taylor, June 20, July 6, 1926; Lafayette Co., near Lewisville, Nos. 2224, 2308, 2309, R. E. McEntyre.

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A New Species of Genus Eumeces from New Mexico

EDWARD H. TAYLOR

Abstract: A new species, *Eumeces gaigei,* belonging to the *E. multivirgatus* group is described from Taos, New Mexico.

THE following species was discovered in June, 1929, in the mountains near Taos, New Mexico, at which time two specimens were taken. These were entered in the Kansas University Museum catalogue as *E. humilis*? In 1932 one of these specimens had the skull removed and studied by R. H. Kingman (*loc. cit.*).

When specimens of the true *E. humilis* were later discovered in New Mexico it became apparent that the Taos form had been wrongly associated with that species. The relationship is, however, with that species, but this should not, I believe, be regarded as a subspecific relationship.

Eumeces gaigei sp. nov.

Eumeces multivirgatus Mosauer, (part) Occ. Papers Mus. Zoöl. Univ. Michigan, No. 246, June 9, 1932, pp. 12-14, pl. I (No. 70517).

Eumeces humilis? Kingman, Univ. Kansas Sci. Bull., vol. XX, No. 15, May 15, 1932, issued Oct. 1, 1932 (Bull. Univ. Kansas, vol. XXXIII, No. 10, 1932, pp. 273-293, pl. XXXIII, figs. 1 and 2 [skull]).

Type. Kansas University No. 7300; collected near Taos, New Mexico, June 13, 1929, by E. H. Taylor; paratype No. 7301 (skull removed).

Diagnosis. A medium-sized species, characterized by the absence of a distinct lateral line and forking lines on the head; the presence of typical dorsolateral lines following the middle of the third scale row, and separated by four whole and two, one-third scale rows.

Brown lateral stripe very narrow; limbs short, not meeting when adpressed; subcaudals widened; postnasal present or absent; two postmentals; interparietal not enclosed; seven upper labials; 24 scale rows about the body.

Description of Type. Portion of rostral visible above less than half the size of the frontonasal; internasals large, forming a median suture; frontonasal large, touching anterior loreals, separated from frontal; prefrontals rather large, medially in contact, forming sutures with frontonasal; frontal, posterior loreal, first supraocular, anterior loreal, superciliary, their lengths in the order named; frontal large, a little longer than its distance from the tip of the snout, slightly constricted laterally, in contact with three supraoculars; frontoparietals in contact; interparietal with sides converging posteriorly, not curving; parietals short and broad, not in contact behind interparietal; two pairs of nuchals, of about the same size.

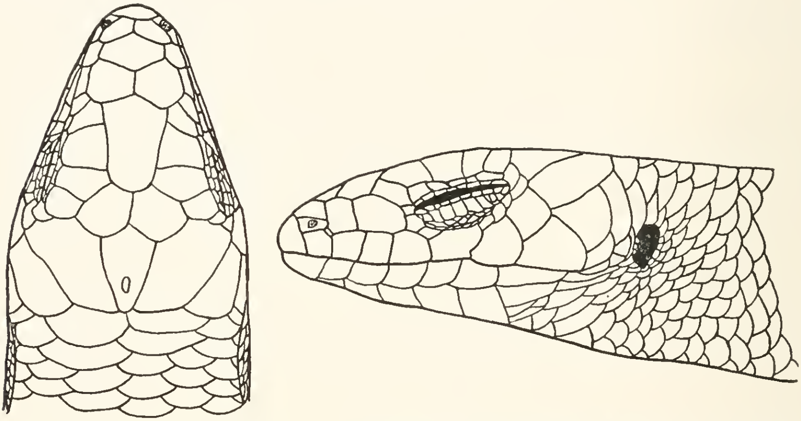

Fig. 1. *Eumeces gaigei* sp. nov. University of Michigan Museum of Zoölogy No. 70517 Guadelupe Mts., Texas, near Texas-New Mexican border. Actual head width, 8 mm.; length, 9 mm.

Nasal typical, divided by a suture, the anterior part largest; postnasal present; anterior loreal distinctly higher than wide, higher than the posterior; latter longer than high, touching two or three labials; presuboculars two (one on right side); six (right) or seven (left) superciliaries; four supraoculars; four postsuboculars; median upper palpebrals directly in contact with superciliaries; two rather large plates on lower eyelid, separated from subocular by two rows of granules; primary temporal large, practically of same size as the lower secondary temporal, with which it forms a suture; upper secondary temporal slightly wider posteriorly than anteriorly; tertiary temporal high, slender, separated from ear by two scales.

Seven upper labials, the first usually the smallest, the seventh (last) largest; the subocular labial larger than usual, approaching or equalling size of sixth labial; seventh labial separated from ear by two pairs (superimposed) of scales; one minute ear lobule; mental large, with a larger labial border than rostral; two postmentals; three pairs of chinshields, the first in contact; postgenial large (broken abnormally into two scales), bordered on inner side by a scale longer than wide; six or seven lower labials.

Scales in parallel rows, about equal in size around the body; scales around neck behind ear, 32; about narrow part of neck, 26; in axillary region, 32; about middle of body, 24; 16 about base of tail at first widened subcaudal; subcaudals nearly double width of adjoining scale row; six preanals, the median pair much enlarged, the outer scales overlapping inner.

Limbs short; the area of granular axillary scales greatly reduced, only one or two rows; none behind insertion of hind limbs; wrist tubercle not strongly differentiated; the scales on wrist and posterior part of palm equal in size, all rather large; lamellar formula for fingers: 5; 8; 10; 11; 6. Heel with two large plates in contact, these each preceded by a single larger scale; scales on sole subequal and for the most part imbricating; lamellar formula for toes: 5; 9; 11; 12; 8. Terminal scales not tightly bound about claw. Ear small, surrounded by about 16 scales; scales on side of neck with usually two pits, these obsolete on sides of body; pits occasionally three in axillary and postfemoral region.

Color. (The type is somewhat discolored by formalin.) Above brownish, the scales showing an anterior and a posterior darker area; no evidence of a median line or bifurcating lines on head; a dorsolateral line begins on the anterior supraocular and continues back onto the tail following the middle of the third scale row, as a series of light dots. The lateral line begins on the rostral, but cannot now be traced quite to ear; chin, anterior part of throat and anal scales light; underside of regenerated tail light.

Remarks. The two specimens in the Kansas University Museum were collected in barren hills along a stream about a mile from the large Indian village near Taos through which the stream flows. They were found under small, flat rocks on a steep hillside, and appeared to be making burrows, as the earth was freshly disturbed;

they took refuge in the burrows, which extended three inches below the surface.

I made journeys to Taos in 1930 and 1934, hoping to discover more specimens, but without result.

The Michigan specimen, which I have been permitted to examine through the kindness of Mrs. Gaige, was collected in the Guadalupe Mountains by Dr. Walter Mosauer. I at first believed it to be an aberrant discolored *E. multivirgatus*.

Measurements of *Eumeces gaigei* sp. nov.

Museum	KU	KU	MU
Number	7300	7301	70517
Sex	♀	♀	♀
Snout to vent	66	62.7	59
Snout to eye	5	5	4
Snout to ear	11.8	11	10
Snout to foreleg	22	18	16
Axilla to groin	40	39.4	35.5
Width of head	8.7	8.2	7.8
Length of head	10	10	9.2
Width of body	12	11.9	10
Foreleg	14	13.8	13
Hind leg	19	18.7	18
Longest toe	12	12	11

A fourth specimen, badly dried, but still showing well the original coloration, is in the American Museum of Natural History. Through the kindness of Dr. G. K. Noble I was permitted to examine it. The color characters are practically identical with those of the Michigan specimen, and differ from young *E. multivirgatus* from the same locality.

Variation. The specimen in the University of Michigan shows the color markings very distinctly. These are as follows:

Above olive-brown, the outer edges of the scales of the first and second rows with darker brown coloration which forms a dim line following edges of first and second row, and second and third; the dorsolateral white line begins on supraocular or anterior edge of parietal, passes back along the middle of the third scale row, the upper and outer edges of which are dark brown; the light line appears as a series of dots, since the posterior edge of each scale is also somewhat darker; a broad, dark-brown line begins behind eye, passes above shoulder and becomes reduced to a narrow lateral line which passes above edges of the fourth and fifth scale rows; this is bordered above and below by dotted lines of ground color, slightly lighter than that on back; a light labial line from second labial passes above ear and stops; a lateral line begins at middle of ear and passes back to above arm and becomes lost; chin and throat light, belly bluish-gray; undersides of legs and anal region light; anterior part of head dark brown, no bifurcating lines visible.

The young specimen in the American Museum, also from the Guadalupe Mountains, has the brown ground color with the dotted dorsolateral lines cream yellow; along the median part of the body are a few lighter flecks on the scales, but in no sense a median line. This specimen differs much from a young *E. multivirgatus* taken in the same locality.

The scale variation in this species is negligible save that in the Michigan specimen a typical postnasal is absent. On one side, however, is a small scale partially fused to (or separated from) the upper posterior part of the first labial.

Relationship. Despite the scale relationship of this form with *E. multivirgatus,* I do not regard it as a subspecies, since the two forms occur together from northern New Mexico (Taos) to Texas (Guadalupe Mountains). Much herpetological collecting remains to be done in New Mexico and Arizona before a clear picture of this form and its relationships can be known.

Whether the specimen in the United States National Museum (No. 5263), from the northern boundary of Texas, one of the types of *epipleurotis,* belongs to this form cannot now be stated, since the specimen is in such a condition that it cannot be identified with any degree of certainty. I propose to designate USNM No. 9219, Fort Kearney, Nebraska, as the *lectotype* of *epipleurotus,* since it appears that the description was drawn from this specimen. It is undoubtedly a specimen of *E. multivirgatus* and is still in a good state of preservation.

Distribution. The species is known only from the states of New Mexico and Texas, and from the following localities: New Mexico, Taos Co.: Near Taos (KU, 2; types); Eddy Co.: Guadalupe Mountains (AMNH, 1). Texas, Culberson Co.?: Near Frijoles (MU, 1).

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Observations on the November Birds of Western Kansas

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IT HAS been known for many years that many species of western birds migrate eastward, probably down the river valleys of the Cimarron, Arkansas and Smoky Hill into western Kansas, but no work has been done there in the winter months since the time of Goss, who collected at Wallace in October, 1883, and again a few years later. However, he was too early to get many of the winter visitant birds. Scattering reports of such birds as the Pinon Jay (*Cyanocephalus cyanocephalus*), Clarke's Nutcracker (*Nucifraga columbiana*), Townsend's Solitaire (*Myadestes townsendi*), and the Mountain Bluebird (*Sialia currucoides*), convinced me that western Kansas would be a fertile field for a November collecting trip.

Accordingly, on October 30, 1934, in company with Mr. Fred Hastie, I left Lawrence, arriving on the Cimarron river, about twelve miles north of Liberal, on the evening of the 31st. The river here was quite narrow, but was flowing a good stream of water, too deep to wade easily, except in a few places. The valley of the river was quite well timbered—better, in fact, than any other western Kansas river we saw. The trees were all cottonwood (Populus) and willow (Salix).

On the north side of the river the land rose abruptly in a series of low sand hills covered with sagebrush, this finally giving way to buffalo grass, which occupied the uplands. Most of the flood plain of the river was on the south side, where it was quite grassy even to the water's edge. A few places here were low, and filled with pools of water, or encrusted with alkali. Wherever the land had been plowed, it had grown up with Russian thistles, which was the only thing to keep the sand from drifting. This was distinctly a grazing country.

On November 7 we moved to Morton county, again camping on the Cimarron, this time about twelve miles northeast of Elkhart, on the Walsh ranch. Here the river was almost completely dry, only a few shallow pools being left here and there in the sand. The cottonwood timber in which we were camped was almost the only timber for miles up and down the river, and covered an area about one mile long by one-fourth mile wide. The uplands were all in buffalo grass, which came down almost to the edge of the river, and there was not much sagebrush. Thistles grew only where the land had been plowed, and since the Walsh ranch, of some thirty-six square miles, was primarily a cattle ranch, there was little of this weed to be seen.

On November 15 we drove north to the Shanstrum ranch, two miles east of Coolidge, on the Arkansas river. The land along the river here was irrigated, and the chief crops were alfalfa and sugar beets. North of the river the land rose abruptly into a series of high, steep bluffs, and the uplands were covered with a good stand of buffalo grass. On the south, for several miles, were sand hills covered with sagebrush. The river itself is a wide, shallow stream, almost choked with sand. One could wade it almost anywhere without going much more than ankle deep. The only timber was a scattering line of stunted trees perhaps fifty yards wide, mostly on the south side of the river. Here Mr. Hastie returned home on the train, and I finished the trip alone.

From November 20 to 25 I was camped on the south fork of the Smoky Hill river, about three miles southwest of Wallace, in Wallace county. Wallace county is the highest county in the state, one point near the Colorado line reaching an altitude of 4,135 feet, while the town of Wallace is slightly more than 3,800 feet.

Here I found the Smoky little more than a creek, hardly more than ten feet wide in most places, but too deep to wade. Most of the timber here was willow, and was very old and twisted by the wind. Only a very narrow strip was timbered, but there was an abundance of large rank weeds, which gave shelter to large flocks of sparrows. Some of the ranchers here had part of their ranches irrigated by wells, but irrigation was not used to the extent that it was in the Arkansas valley. Some sagebrush grows here in the river valley, but it is rather scattering. The upland is largely in buffalo grass.

From Wallace I drove to southeastern Cheyenne county, where I stayed on the farm of Mr. John White, 19 miles southeast of St. Francis. The land here is rather hilly, and the upland is in buffalo grass, but it is not much of a cattle country. The chief crop is corn. A number of small creeks wind about in the lower land, and a number of "lagoons" or small ponds resembling buffalo wallows are found here, but at the time of my visit they were all dry. Several small patches of stunted trees were scattered about where early settlers had planted them, but dust and sand had blown in among them so badly that they offered little shelter to birds.

Up until the time I reached Wallace county the weather was warm—almost too warm for comfort while collecting. The thermometer registered above seventy almost every day, and we had no freezing nights. In Wallace county, however, the weather changed, and from that time on it was rarely much above freezing. A blizzard blew up on the night of November 26, in Cheyenne county, and two or three inches of snow fell. The Republican river was almost frozen over, and the unfrozen part was full of floating ice.

In conclusion, I wish to express my appreciation to Mr. C. D. Bunker, assistant curator in charge of the Museum of Birds and Mammals, University of Kansas, who secured the financial assistance necessary to carry on this work, and who allowed me free access to the skin collection in classifying the birds which were collected. These are now in the collection of the Kansas University Museum.

LIST OF SPECIES

1. *Gavia immer* subsp.

Loon

A single specimen of this bird was picked up dead on the prairie about one-half mile north of the Cimarron river on November 9. It had been partly eaten by hawks, but was readily recognizable. A large hole in the sternum might have been made by the bill of a hawk, but was probably a bullet hole. The bird had probably been shot on the river and flown up on the prairie before dying. While subspecific identification of remains of this kind is a precarious matter, I believe this should be referred to *Gavia immer elasson* Bishop. The wing* measures 342 mm., and the exposed culmen 62.3 mm. This was the only loon seen on the trip.

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* Measured with a steel tape, following the curve of the wing, after the method of Bishop, The Auk, Vol. XXXVIII, No. 3, July, 1921, pp. 364-370.

2. *Ardea herodias treganzai* Court

Treganza's Heron

Great Blue Herons were seen in every locality except Cheyenne county, where the weather was too inclement for them to be expected. A bird of the year was shot on the Cimarron in Seward county, on November 2. Another was seen in Morton county on November 9, and in Hamilton county one stayed on the Arkansas river, where it was seen daily. The last date for the species was November 20, when one was observed on the Smoky Hill river, three miles southwest of Wallace. The single specimen taken, a female, is indistinguishable in color from an unsexed bird from Converse county, Wyoming. The measurements are too small for anything but Treganza's Heron. It measures as follows: Wing 425; tail 155; culmen 124; depth of bill 27.5; tar. 154.

3. *Anas platyrhynchos platyrhynchos* Linnaeus

Common Mallard

Mallards were seen daily throughout the trip except in Cheyenne county. They were especially common in Seward county, where a flock of a thousand or more stayed on the Cimarron. Curiously enough, this large flock was made up entirely of drakes. During the day the flock fed in a field of kaffir corn not far from the river, coming in to the water only in the evening about sundown. Although this was supposed to be a state game reserve, these ducks were hunted every day of the open season.

Ducks were not so common in Morton county, because the river was dry, except for a few pools here and there. They were usually seen in small bunches of three or four. On the Arkansas and Smoky Hill rivers they were quite common, but did not occur in the huge flocks which were seen in Seward county. A few hen birds were seen in Hamilton and Wallace counties, but even here the males were much more common.

Ducks, sp. On November 23, in Wallace county, three ducks passed over, flying quite high. They appeared to be the white-winged scoter (*Melanitta deglandi*), but since I have never seen this species in life I could not be certain. There are a number of records of this duck from eastern Kansas.

4. *Mergus merganser americanus* Cassin

American Merganser

A flock of ten American mergansers was seen on the Arkansas river, two miles east of Coolidge, on November 16. They were floating down the river, some with heads submerged in the shallow water as if searching for food. When they saw our tent they took wing at once, and flew swiftly away to the east.

5. *Accipiter velox velox* (Wilson)

Sharp-shinned Hawk

Two specimens of this little hawk, a male and a female, were taken in Seward county on November 2 and 5, respectively. The female was seen to catch a red-winged blackbird (*Agelaius phoeniceus*) from a large flock which was feeding in a patch of weeds. The blackbird was knocked down with a blow of the hawk's foot, and pounced upon before it could recover. When flushed, the hawk attempted to carry its prey away, but the latter was so heavy that flight was slow and laborious. No other individuals of this hawk were seen in other localities.

6. *Accipiter cooperi* (Bonaparte)

Cooper's Hawk

The Cooper's hawk was recorded only once, when one flew into the cottonwood grove where we were camped in Morton county, on November 11. It was not collected.

7. *Buteo borealis calurus* Cassin

Western Red-tailed Hawk

The western red-tail was recorded from every locality in which we collected. It was often seen in company with rough-leg and marsh hawks, eating jackrabbits which had been killed on the highways by automobiles. A solid black hawk seen on the highway six miles north of Elkhart on November 13 was probably of this subspecies. The western red-tail was more common in Morton county than anywhere else, probably because the only timber for miles around was on the Walsh ranch. Jackrabbits were abundant, and furnished most of the food of all of the large hawks. A number of specimens were collected in Morton and Hamilton counties.

8. *Buteo lagopus s. johannis* (Gmelin)

American Rough-legged Hawk

This large hawk was found to be common everywhere except in Seward county, where it was not recorded. Its habits were much the same as the last species. Most of the individuals seen were in the typical adult plumage, with a wide, solid black band across the abdomen, but a male taken in Morton county on November 14 was in the black phase, appearing much the same as the black phase of the western red-tail, except that the legs were feathered to the toes. Specimens were taken in Morton, Hamilton and Wallace counties.

9. *Buteo regalis* (Gray)

Ferruginous Rough-leg

We found this to be the most common of the buteos of western Kansas, and far more conspicuous than any other hawk except the marsh hawk. It was recorded from every place where collecting was done, and was seen along the roads constantly, where it sat on telephone poles or fence posts, apparently waiting for a rabbit to be killed. On November 29 it was recorded as far east as Gove county, where the ground was deeply covered with snow. Eight specimens were collected.

10. *Aquila chrysaëtos canadensis* (Linnaeus)

Golden Eagle

Golden Eagles were quite common in Morton county. On November 9 as I was riding with the Walsh boys in an automobile over the prairie, we saw one sitting on the prairie perhaps a quarter of a mile away. It flew almost immediately, going toward the river. Later, we saw it again, flying up and down the dry bed of the river, close to the ground. On November 14 I saw an immature golden eagle in the river bottom near the grove in which we were camped. It perched in a small tree, hardly more than a shrub, about eight feet from the ground, for several minutes before it flew away to the west, showing the white base of the tail and white patches on the under side of the wings to good advantage. In the afternoon of the same day an eagle, possibly the same one, flew into the grove near our tent. The men at the ranchhouse shot at it with rifles, but the range was too great.

On November 15, in Hamilton county, we saw two eagles perched in a giant cottonwood tree in a small canyon six miles north of Coolidge. There was a large nest in the tree, which the birds had probably used the previous summer. When we stopped the car to look at them, both flew up the canyon and perched on the edge of the rocky rim, walking about uneasily. When we followed they flew back down the canyon, and as we returned to Coolidge both were again perched in the nest tree. Eagles were not seen to soar at any time, and none were seen after November 15. They usually stayed on the uplands.

11. *Haliaeetus leucocephalus leucocephalus* (Linnaeus)

Southern Bald Eagle

Only one eagle which could certainly be identified as the bald eagle was seen. This was an adult which flew up from the prairie in front of the automobile, on November 9, in Morton county. It flew away toward the river and was not seen again. Ranchers here say that the bald eagle is much more rare than the golden, but this may be because they do not distinguish between the latter and the immature bald eagle. No specimens were taken, but since all known specimens from the state are referred to the southern subspecies, it is safe to conclude that this one was also of that race.

12. *Circus hudsonius* (Linnaeus)

Marsh Hawk

This hawk was seen in every locality where collecting was done, and along most of the highways of the state where it fed on dead jackrabbits. It was perhaps less common along the Arkansas river than in any other locality, as were most of the other hawks observed. Curiously enough, in Seward county the adult males were more common than the immature males and females by at least three to one, while in all other localities the reverse was true. In Morton county no blue males were seen at all, and in Wallace county only one or two in four days. On November 6, in Seward county, a marsh hawk attacked a ferruginous rough-leg and a western red-tail which were soaring high overhead, and drove them rapidly away, although it did not touch them at any time.

13. *Falco mexicanus* Schlegel

Prairie Falcon

The Prairie Falcon was seen in Hamilton, Wallace and Cheyenne counties only. A female was taken near the tent in Hamilton county on November 17. On November 21, on the south fork of the Smoky Hill river, in Wallace county, a prairie falcon flew up the river with the wind, going faster than any bird I have ever seen, with the possible exception of the chimney swift. It was close to the water, and cut in and out with the meandering of the little stream faster than one would believe possible. It was apparently looking for ducks, but finding none it left the river and flew away across the uplands. Another was seen as it flew from a fence post along the highway in Cheyenne county, on November 28.

14. *Falco sparverius phalaena* (Lesson)

Desert Sparrow Hawk

Sparrow hawks were seen on a number of occasions, but in Seward and Morton counties only. There may be some doubt as to the subspecific status of the birds seen in Seward county, but there can be no doubt about an adult male taken in Morton county on November 14. It is much paler than skins from the eastern part of the state, and matches specimens from Golden, Colorado, very well. No sparrow hawks were seen after November 14.

15. *Tympanuchus cupido americanus* (Reichenbach)

Greater Prairie Chicken

Prairie chickens were seen only in Hamilton and Cheyenne counties, although ranchers in Wallace county said that a few were left in that vicinity. As we were pitching camp in Hamilton county on November 16 a flock of ten flew low over our heads and across the river. On the 17th a hunter had three "chickens" in his car. One was of this species and the other two of the following species. On November 26 a small flock was flushed from a field of shocked grain in Cheyenne county about dark, and on the 28th a flock of about thirty flew across the road in front of the car a few miles east of St. Francis. Mr. John White, at whose farm I stayed while in Cheyenne county, says that the prairie chicken is rapidly decreasing since the introduction of the ring-necked pheasant. The latter has increased in the northwestern part of the state until the Fish and Game Commission has seen fit to place a two-day open season upon it.

Prairie chickens are persistently hunted out of season. Hunters in the Arkansas river valley said that during the open season in October the chickens were on the open prairie and practically impossible to approach. Later, they come into the valley and feed in the grain fields, where they can be more successfully hunted.

16. *Tympanuchus pallidicinctus* (Ridgway)

Lesser Prairie Chicken

The foregoing remarks may be applied to this species as well as the last, and some of the flocks listed might well have been of this species. The only specimens certainly identified were the two in the possession of the hunter at Coolidge. One of these was presented to the museum as a specimen. It is very probable that these two species keep more or less to themselves in the field, for this hunter told me that the three birds in his possession, which were of the two species, had been taken from two different flocks.

17. *Colinus virginianus taylori* Lincoln

Bob-white

The bob-white quail is common along all of the streams wherever it can find cover. Most of the ranchers of the state do not allow anyone to shoot the quail, and as a result almost every patch of scattering timber has its covey of these birds. A dozen birds were seen to run across the road from a field of kaffir corn to a dense thicket of Russian thistles in Seward county on November 6. A pair was taken from a covey in Morton county on November 8, a male in Hamilton county on November 18, and a covey of about a dozen or fifteen was seen repeatedly in Wallace county.

The three specimens taken, and other specimens from western Kansas, are distinctly different than Douglas county skins. They agree very well with Lincoln's* published description of taylori, from Yuma county, Colorado. This appears to be a perfectly good subspecies, which ultimately will be recognized.

18. *Callipepla squamata pallida* Brewster

Arizona Scaled Quail

This beautiful quail was seen only in Hamilton county, where two males were taken on November 18, but it was taken in Morton county by Burt in the summer of 1927, and Mr. Walsh told me that a few were seen on his ranch occasionally. In Wallace county I was told by a rancher that when he came to that country in 1888 the "topknot" quail, as it is called locally, was quite common along the Smoky Hill river, but that he has not seen any of the birds for several years. They are said to be unable to withstand severe winters, so that they very seldom become common. People at Coolidge said that the severe winter of 1918-'19 almost exterminated them in that region, and that they were just beginning to come back to normal numbers.

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* Lincoln, Frederick C. Description of a New Bob-white from Colorado. Proc. Biol. Soc. Wash. XXVIII, 1915, 103, 104.

19. *Phasianus colchicus torquatus* Gmelin

Ring-necked Pheasant

The ring-necked pheasant has been introduced into various parts of western Kansas by the Fish and Game Commission, as well as by private individuals. In some places it has secured a foothold and is increasing, as in the northwestern part of the state where a two-day open season was granted in fifteen counties in 1934. It is not so common in the southwest. Cock birds were seen in Seward county on November 1, 4, and 6. They were not seen in Morton county or in Hamilton county, although the ranchers said there were a few in each place. A female was flushed from a thick growth of weeds along the Smoky Hill river in Wallace county, and the birds were seen daily in Cheyenne county. No specimens were collected, as the sentiment of the ranchers is distinctly against it. Most of them exacted a promise to spare the quail and pheasants before allowing us to collect on their property.

20. *Oxyechus vociferus vociferus* (Linnaeus)

Killdeer

A flock of about a dozen of these plovers stayed near our camp in Seward county, dividing their time between the sand bars in the river and the flat, grassy meadows to the south. They were never seen on the north side of the river, which was largely sagebrush. One specimen was taken on November 1. This species was also heard calling from the sandbars of the Arkansas river on November 16 and 17.

21. *Capella delicata* (Ord)

Wilson's Snipe

A single Wilson's snipe was flushed from the grass at the edge of Rose creek, a tributary of the Smoky Hill river, four miles southwest of Wallace, on November 22. It was the only one seen on the trip.

22. *Zenaidura macroura marginella* (Woodhouse)

Western Mourning Dove

Western mourning doves were recorded from Seward, Hamilton and Wallace counties, but they were decidedly uncommon, as only three or four were seen, and on only four or five different occasions. They spent most of their time on the ground, where they were protected from the cold wind which blows almost constantly in this treeless region. One male was taken at Coolidge on November 19.

23. *Geococcyx californianus* (Lesson)

Road-Runner

A single adult male, taken in Seward county, November 6, was the only road-runner seen on the entire trip. Ranchers in Morton county said that it was often seen there, but we did not see one. At Coolidge it is said to be very rare.

24. *Tyto alba pratincola* (Bonaparte)

Barn Owl

The only barn owl seen on the entire trip was collected in Seward county, on November 6. Curiously enough, although there was plenty of timber, some of it quite large, near by, this bird was roosting on the ground in a large patch of Russian thistles and other weeds. It was less than two hundred yards from the nearest trees, and within fifty feet of a road.

25. *Otus asio aikeni* (Brewster)

Aiken's Screech Owl

A male screech owl taken from a hollow willow tree at Coolidge, on November 18, is typical of this subspecies, agreeing perfectly with specimens from Barber and Comanche counties, identified by Oberholser. The only other screech owl seen was flushed from a hollow cottonwood stub in Morton county on November 8. Although we were camped in timber, which seemed to be ideal for screech owls, throughout the trip, we did not once record the call of the bird.

26. *Bubo virginianus virginianus* (Gmelin)

Great Horned Owl

A female, taken in Morton county on November 14, is indistinguishable from eastern Kansas specimens, either in color or size. This bird must have been a straggler from the east or northeast, for it can hardly be explained in any other way. Other specimens taken east and north of this locality are distinctly referable to the next subspecies.

27. *Bubo virginianus pallescens* Stone*

Western Horned Owl

The great horned owls of western Kansas are a puzzle, as they do not seem to fit in with any known subspecies. It is probable that we have here a case of intergradation of three subspecies, pallescens, occidentalis, and virginianus. Of these three, pallescens is supposed to be the palest, yet our Kansas birds are paler than specimens before me which were taken in Arizona and Idaho. In fact, the Arizona birds are darker than the Idaho ones. One of the characters of pallescens is supposed to be the immaculate white feet, yet an unsexed bird from Navajo county, Arizona, has the feet rather heavily barred. Certain Kansas specimens show unmistakable influences of virginianus in the very dark shade of the gray barring of the underparts, while others are of a light grayish buffy shade, rather than dusky. In all, hovever, these dark markings are narrow, so that the white feathers show very prominently. The Navajo county, Arizona, specimen (K. U. 19397), has these cross barrings so wide that the underparts appear to be almost solidly gray, marked with buff. These markings are narrowest on a female from Stockton, Kansas. It may be that a larger series of Arizona and New Mexico birds would show many very pale ones. As near as I can tell from the series at hand, however, the Kansas bird averages lighter in color than either pallescens or occidentalis.

Size difference between the two subspecies is slight, being a matter of average differences only. Measurements of specimens in the K. U. Museum are as follows:

Coll. No.	Sex.	Locality.	Wing.	Tail.	Culmen (from cere).
17749	♂	Bannock county, Idaho..............	346	210	27.8
18122	♂	Maricopa county, Arizona...........	335	190	27.5
20881	♂	Hamilton county, Kansas............	335	198	27
11953	♂	Wallace county, Kansas..............	349	188	27.5
17748	♀	Bannock county, Idaho..............	372	223	30
19397	?	Navajo county, Arizona.............	371	235	29
16693	♀	Baca county, Colorado...............	375	215	30
21053	♀	Hamilton county, Kansas............	361	224	28
20883	♀	Seward county, Kansas...............	371	218	31
10673	♀	Rooks county, Kansas...............	367.5	220	28.1

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* Since this paper went to press I have had the opportunity to examine a series of skins of *B. v. pallescens* and *B. v. occidentalis* from Arizona, Texas, Minnesota and Montana, kindly loaned to me by the U. S. National Museum. I find that the Navajo county, Arizona, skins mentioned above are abnormally dark individuals, and that the Kansas specimens must be called *Bubo virginianus occidentalis* Stone instead of *B. v. pallescens* Stone. The Kansas specimens differ from Arizona and Texas birds in having a distinct, wide, dusky bar, which is sometimes edged with two narrow white bars, on the feathers of the back, while the skins of *pallescens* are more inclined to be evenly mottled with gray and white, without the

These western Kansas owls are provisionally placed under the subspecies *pallescens*, pending the opportunity of comparing them with a more extensive series of Arizona skins.

28. *Speotyto cunicularia hypugaea* (Bonaparte)

Western Burrowing Owl

Only two burrowing owls were seen on the trip. The first was collected as it sat at the entrance to a burrow in a sand bank about six miles north of Elkhart. However, it was so badly torn that it had to be discarded. This burrow looked as if it might have been dug by the owl—at least it was not a prairie-dog burrow, in which most of these owls live. Another was seen on the same day, about two miles north, about some prairie-dog burrows, but it was not taken.

29. *Asio wilsonianus* (Lesson)

Long-eared Owl

Two long-eared owls were taken in the timber on the Walsh ranch, Morton county, on November 8 and 13. They were the only owls of this species seen.

30. *Megaceryle alcyon alcyon* (Linnaeus)

Eastern Belted Kingfisher

A male of this species was taken on the Smoky Hill river three miles southwest of Wallace, on November 24. It was the only one seen.

31. *Colaptes cafer collaris* Vigors

Red-shafted Flicker

These birds were very common throughout the region covered on the trip, being found wherever there were any trees. While no individuals of *C. auratus* were noted, many of the red-shafted birds seen were hybrids. Some of them could be distinguished in the field, the shafts of the feathers being orange instead of red. Probably very few of the flickers are typical of either species. A few specimens were taken.

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dusky bar. In this character the Kansas birds agree very well with *occidentalis* from Montana, Idaho and Minnesota, although in some skins it is not so evident as in true *occidentalis*. This dusky bar gives the Kansas birds the darker color of *occidentalis*, although one or two are as light as *pallescens*. In a series, the Kansas birds are more heavily barred on the underparts than Arizona specimens, agreeing again with *occidentalis*. The feet are more heavily marked than either *occidentalis* or *pallescens*, indicating the influence of *virginianus*. One skin (K. U. 20882) from Wallace county has the feet as heavily marked as typical *virginianus*, but the ground color is white instead of buffy.

32. *Sphyrapicus varius nuchalis* Baird

Red-naped Sapsucker

The red-naped sapsucker has not been reported in Kansas since the days of Goss, who took specimens in Wallace county. The writer took an immature female of this species in some dead timber in Morton county on November 14, and saw another in Hamilton county on November 17. Neither of these birds was heard to utter a sound, both being found by the tapping on the tree trunk. The noise was hardly as loud as that made by a downy woodpecker. This sapsucker is probably more common in migration than it is generally considered to be.

33. *Dryobates villosus villosus* (Linnaeus)

Eastern Hairy Woodpecker

The hairy woodpecker was decidedly uncommon. While it was recorded from each of the collecting stations, except Cheyenne county, it was seen only once or twice at each place. Five specimens were collected. While these are not typical of the Eastern race, they must be so regarded because the wing coverts are spotted as conspicuously as in the birds from Douglas county. In general, these skins are slightly larger than typical villosus, and the underparts average whiter, thus showing intergradation with *D. v. monticola*. True monticola has been taken in Baca county, Colorado, but none of these birds can be referred to that race. Measurements of the Hairy woodpeckers collected are as follows:

K. U. No.	Locality.	Sex.	Wing.	Tail.
20896	Morton county	♂	125	73.5
20898	Hamilton county	♂	127	77
20895	Seward county	♀	123.5	76
20899	Wallace county	♀	122.5	76
20897	Morton county	♀	123.5	75.5

34. *Dryobates pubescens medianus* (Swainson)

Northern Downy Woodpecker

The downy woodpecker was still more uncommon than the hairy woodpecker, except in Wallace county, where four were taken. In other localities it was recorded only once. As in the last species, the birds average larger than the birds in Eastern Kansas, but still not large enough for *D. p. leucurus*, which we had hoped to find here. In addition, the wing coverts are spotted as in the eastern bird.

35. *Dryobates pubescens pubescens* (Linnaeus)

Southern Downy Woodpecker

A single female taken on the Cimarron in Seward county must be referred to this southern race. This may indicate that the Austroriparian Zone extends up the Cimarron river in southwestern Kansas in the same way as it does in the southeastern part of the state.* However, this cannot be determined satisfactorily until more collecting can be done here. The wing measurement of the bird taken was 89 mm. It was the only downy woodpecker seen in that locality.

36. *Otocoris alpestris leucolaema* (Coues)

Desert Horned Lark

This is undoubtedly the most common and characteristic bird of western Kansas, winter and summer. It is the only bird which was seen abundantly in every locality in which we collected, and it seemed to be present in every form of habitat except timber. It was found on the uplands running about over the wind-swept buffalo grass, with no companions except longspurs and hawks. It was equally at home in the sandy bed of the river, or the gravel roads which stretch in every direction. We were never out of sight of them for more than an hour of the daylight hours that we were away. They were present in some of the most desolate sand dunes in the southwestern part of the state. Along the rivers, large loosely-flying flocks came down to drink, and others seemed to spend a great deal of time flying back and forth across the river from bluff to bluff.

In Wallace county I found these larks and certain other birds attacked with some kind of a disease which seemed to paralyze them, so that they were unable to fly. About noon, on November 22, I found a bird in this condition, which I took to the tent and placed in a box. It made no attempt to escape, but merely placed its head in a corner and remained quiet. At 9:30 p. m. it was in the following condition (quoting from my notes, taken at the time):

> "It appears to be almost completely paralyzed. The feet are drawn up to the body, but the lower half of the legs, at least, can be shuffled quickly, so that it can move about to some extent. When prodded with the finger it can stand almost upright for a few moments, but soon resumes a lethargic appearance. The body is extremely bloated, the air, or gas, seeming to be under the skin, rather than in the body cavity. The skin on the back of the neck, espe-

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* Long, W. S. The Distribution of the Downy Woodpecker in Eastern Kansas. Amer. Mid. Nat., vol. XV, pp. 598-600.

cially, is tightly distended, giving the bird a curious humped, or arch-necked appearance, made more noticeable by the fact that the bill is pointed downward. The head is apparently immovable, as well as the wings. There is no discharge of any kind from mouth or anus. The eye is very bright, but the bird is drowsy, and remains most of the time with eyes closed. When moved, or touched, however, it becomes wide awake in an instant, only to lapse after a moment into a lethargic condition. It seems hot and feverish, although this may be because my hands are cold at the present time. Respiration and pulse are slow, for a bird. It seems to be almost dead."

This bird was dead next morning. The body was sent to the Biological Survey, where the disease was diagnosed as pneumonia.

37. *Aphelocoma californica woodhousei* (Baird)

Woodhouse's Jay

This dashing jay was found only in Morton county, where five specimens were taken. Ranchers say that it is found there all year around, but if so, it must have migrated in during the last six or seven years, for W. H. Burt and his party from the K. U. Museum did not find it there when they were collecting during the summers of 1926 and 1927. Perhaps the most striking thing about this jay is the loud, harsh, cry of sáca, sáca, sáca, with the accent on the first syllable. It suggests the note of the magpie, but is double instead of single. We found this bird to be rather quarrelsome, as on two occasions it was seen to dash into a flock of western meadowlarks and scatter them in all directions. Ranchers call them "Bluebirds." The Woodhouse's jay has not been reported in Kansas previous to this time.

38. *Pica pica hudsonia* (Sabine)

American Magpie

Magpies were found to be fairly common in the extreme western part of the state, except in Hamilton county, where they were abundant. One was seen in Morton county on November 9, and another was seen in Wallace county on two different occasions, on November 21 and 22. Three of these birds were seen in Cheyenne county, one in an old timber claim on November 26, and two on the Republican river on November 28.

In Hamilton county, however, they are very well established. On the evening of November 16 twenty of them flew from the trees about a farmhouse at my approach, and went down to the river. On several occasions they were seen on the highways, eating dead rabbits with the hawks. They have increased greatly during the last ten or twelve years, for Linsdale† did not find them present in such numbers when he visited this same ranch in the summer of 1921. He reported a small flock seen on July 11, and a single bird on July 12, and that Mr. Shanstrum said they had nested on the place in recent years. Now they are the most common of the larger birds. The timber on the south side of the river contained a number of their large, bulky nests, and an apple orchard on the Hines ranch contained at least a dozen nests. We saw at least fifty nests in this locality. A good-sized flock roosted in the Hines orchard, but after we raided them and collected three birds they stopped using the roost. They are as wily and as hard to shoot as the crow in the eastern part of the state. This colony probably became established from a few birds which migrated down the Arkansas river. The four specimens taken are the first Kansas specimens in the K. U. Museum.

39. *Corvus brachyrhynchos brachyrhynchos* Brehm

Eastern Crow

On October 31, after leaving Pratt, we began to see large flocks of migrating crows. For fifty miles or more we drove through an area which was literally swarming with these birds. Long straggling flocks were passing southward, and on the ground, as far as we could see to either side, the wheat fields were black with them. Twenty thousand would perhaps be a very conservative estimate of the numbers of crows that we saw in this narrow strip. In southwestern Kansas, however, the crow is rare. In Seward county we saw three crows, which came about our camp daily. None were seen in Morton county, but in Hamilton county two were observed, on November 16 and 18. They were observed once in Wallace county, on November 23, and in Cheyenne county four were seen along the road near the Republican river, eight miles north of Wheeler.

40. *Penthestes atricapillus septentrionalis* (Harris)

Long-tailed Chickadee

Although we hunted diligently for chickadees, they were not seen until we reached Wallace county, where they seemed to be quite common. Apparently the chickadee is totally absent from southwestern Kansas, as the residents of that area did not recognize the bird when I tried to describe it. The juncos are called "chickadee" around Coolidge, and the horned larks are called "snowbirds," which is the name usually given to the junco. The chickadee was quite common in the willow trees along the Smoky Hill river, where they associated with juncos, downy woodpeckers and tree sparrows.

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† Linsdale, Jean. Notes on Summer Birds of Southwestern Kansas. The Auk, vol. XLIV, No. 1, January, 1927.

41. *Sitta carolinensis nelsoni* Mearns

Rocky Mountain Nuthatch

On November 13, in Morton county, a female nuthatch was found fluttering about in the leaves near the tent. It was unable to fly, and was picked up in the hands. It was the only nuthatch of any kind seen on the trip. It seems to be typical of nelsoni in having a relatively more slender bill than our eastern subspecies, and in having the black centers of the tertials acuminate instead of rounded. It also has the concealed white spots at the nape of the neck which are said to be characteristic of the subspecies. The body was sent to the Biological Survey, but there was no apparent abnormality to cause the death of the bird. This is the first report of the Rocky Mountain nuthatch in Kansas.

42. *Certhia familiaris americana* Bonaparte

Brown Creeper

A female taken in Seward county on November 3 is intermediate toward *C. f. montana*. Observers and collectors farther west should be on the lookout for this western subspecies.

43. *Nannus hiemalis hiemalis* (Vieillot)

Eastern Winter Wren

A female taken in Seward county, November 3, was the only one seen on the entire trip.

44. *Thryomarnes bewicki niceae* Sutton

Nice's Wren

The Bewick's wrens of southwestern Kansas and southeastern Colorado have always presented a serious problem to taxonomists. They have been variously called cryptus and eremophilus by different authorities who examined different series of skins. It is very probable that Sutton has hit upon the solution of the problem in describing this new subspecies.‡ Skins from Morton county are certainly different from cryptus taken in Barber county, as well as true eremophilus from Arizona. One male of this wren was taken in Morton county on November 14. Another male taken in Wallace county on November 24 has been provisionally placed with this subspecies, although it is noticeably more brown above than the Morton county skin. It was taken from a point farther north than any other Bewick's wren in Kansas, and may prove to be a migrant from the Northwest.

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‡ Sutton, George Miksch, A New Bewick's Wren from the Western Panhandle of Oklahoma. The Auk, vol. LI, No. 2, pp. 217-220.

45. *Turdus migratorius propinquus* Ridgway

Western Robin

Robins were found to be rare everywhere except Morton county, where a flock of several hundred was seen daily in the timber. They were noted only twice in Seward county, on November 2 and 4, and once in Hamilton county, on November 18. They were not recorded once from Wallace or Cheyenne county. The three specimens taken are typical of this subspecies, having almost no trace of a white tip on the tail feathers.

46. *Sialia sialis sialis* (Linnaeus)

Eastern Bluebird

Bluebirds were noted on several occasions in Seward county. Two females were taken in Morton county on November 12. They were in company with a flock of mountain bluebirds (*Sialia currucoides*).

47. *Sialia currucoides* (Bechstein)

Mountain Bluebird

Seen only in Morton and Hamilton counties. They were first noted on November 9, when two males were seen on a wire fence on the prairie. A male was collected at this same place on November 11, and another in the timber on the 12th. Three males and a female were taken near the Arkansas river, two miles east of Coolidge, on November 17. Although the species has been reported from the state many times before, the only other specimens known are a male in the Goss collection, taken at Ellis, November 12, 1879, and one taken by Bunker on June 20, 1911, at Tribune. The latter must be considered a straggler.

48. *Myadestes townsendi* (Audubon)

Townsend's Solitaire

Seen only in Morton county. They have much the appearance of a Robin as they perch on a twig, but they have the same habit as the eastern bluebird, of sitting quietly on the lower limbs of a tree and dropping to the ground now and then to pick up an insect. The flight is robin-like. The call-note is unknown, as they were not heard to utter a sound. Three specimens were taken, on November 8 and 10.

49. *Regulus satrapa satrapa* Lichtenstein

Eastern Golden-crowned Kinglet

Golden-crowned kinglets were seen or heard almost daily in Seward and Morton counties, but were not found in any other locality.

50. *Lanius borealis invictus* Grinnell

Northwestern Shrike

This was the most common shrike seen on the trip. Two were taken in Morton county on November 11 and 12. One was seen near Coolidge on November 18, and an immature female was taken in Wallace county on November 21.

51. *Lanius ludovicianus excubitorides* Swainson

White-rumped Shrike

Two white-rumped shrikes were seen along the highway north of Elkhart on November 13, and one was collected at Coolidge on November 18.

52. *Dendroica auduboni auduboni* (Townsend)

Audubon's Warbler

An immature male of this subspecies taken in Morton county was the only warbler seen in western Kansas.

53. *Passer domesticus domesticus* (Linnaeus)

English Sparrow

This sparrow was found to be quite common about all of the ranch houses visited, roosting abundantly about the barns and feed stacks. In Morton county a flock of a dozen or more of these birds lived in the cottonwood grove in which we were camped, apparently roosting in hollow limbs. They were frequently seen in the timber along the river in company with house finches and pine siskins.

54. *Sturnella neglecta* Audubon

Western Meadowlark

The western meadowlark was found to be quite common everywhere in the west. In the early morning, on warm days, the flocks of meadowlarks were in full song until nine-thirty or ten o'clock, after which they became silent. On windy days they were usually found on the south side of a hill where they were protected from the wind and warmed by the sun at the same time. Flocks of a dozen to fifty were often flushed from the sagebrush in the sand hills, but when singing they were nearly always in the trees. As a rule, we found these birds wild and hard to approach.

55. *Agelaius phoeniceus fortis* Ridgway

Thick-billed Redwing

Thick-billed redwings were found in large flocks in every locality except Cheyenne county. The majority of these birds were females, only a few in each flock being males. In Seward county a flock of several hundred of these birds was seen daily in a large patch of weeds, apparently eating weed seed. Measurements of eight specimens are as follows:

K. U. No.	Sex.	Wing.	Tail.	Culmen.	Depth of bill.
20974	♂	118	82.3	21.8	13.5
20978	♂	125.6	96	22.8	12.7
20979	♂	127	93	23	13.6
20980	♂	121	85	22.5	13.5
20975	?	104	78	20	11.4
20976	♀	105	80	21.6	11.9
20977	♀	109.5	81	20	11.9
20981	♀	103.2	79.6	19	11

56. *Richmondena cardinalis cardinalis* (Linnaeus)

Eastern Cardinal

Just at dusk on November 25 two cardinals were flushed from a thick tangle of weeds and willows on the bank of the Cimarron in Seward county. They flew about in the brush for some time, calling excitedly, but it was so dark I was unable to see them. These were the only cardinals encountered on the trip.

57. *Hesperiphona vespertina* subsp.

Evening Grosbeak

On November 18 a boy on the Shanstrum ranch at Coolidge shot a bird, which, from his description, must have been an evening grosbeak. However, it was shot with a .22 caliber rifle, and he threw it away. Since there are no specimens of the evening grosbeak from western Kansas, it would be unwise to attempt any subspecific determination.

58. *Carpodacus mexicanus frontalis* (Say)

Common House Finch

The house finch was found to be quite common in Morton and Hamilton counties. Most of the time it stayed around the ranch buildings with the English sparrows, but occasionally flew into the timber along the rivers. Nine specimens were collected between November 12 and 19. These are the only known Kansas specimens of the house finch.

59. *Spinus pinus pinus* (Wilson)

Northern Pine Siskin

Pine siskins appeared in Morton county on November 12, and were seen daily thereafter in large flocks. They often fed in mixed flocks of juncos and with the house finches. They were not observed in Hamilton county, but appeared again at Wallace on November 21. Several specimens were collected.

60. *Spinus tristis tristis* (Linnaeus)

Eastern Goldfinch

Goldfinches were seen and collected in both Hamilton and Wallace counties. The western Kansas goldfinch was formerly considered to be *Spinus tristis pallidus*, but Dr. A. Wetmore has recently examined a number of skins from Trego county, and referred them all to the eastern subspecies. A male taken in Hamilton county and a female in Wallace county are slightly larger than specimens from the eastern part of the state, but can be matched in color by any number of specimens.

61. *Junco aikeni* Ridgway

White-winged Junco

Four white-winged juncos were seen in Morton county on November 10, and a female collected. They were not seen again until November 21, when they were found to be quite common in Wallace county. They fed with mixed flocks of Shufeldt's and pink-sided juncos, but could be easily separated from them by the larger size, and more white in the tail. Several were collected. All previous records of this species in Kansas prove to be *Junco hyemalis hyemalis* when specimens can be found.

62. *Junco hyemalis hyemalis* (Linnaeus)

Slate-colored Junco

Two slate-colored juncos were taken from a small flock in Morton county on November 9.

63. *Junco oreganus shufeldti* Coale

Shufeldt's Junco

Shufeldt's juncos were found to be very common in every locality except Cheyenne county, where no juncos of any kind were seen. A large series was collected.

64. *Junco mearnsi* Ridgway

Pink-sided Junco

The pink-sided junco was about as common as the Shufeldt's, and had much the same habits, the two species flocking together in every locality where they occurred. A large series was collected. This is the first record for Kansas.

65. *Spizella arborea ochracea* Brewster

Western Tree Sparrow

The western tree sparrow was found in flocks in every locality visited. It was usually found in patches of weeds, but in Seward county it was often found in the sagebrush and in the scattering patches of sand plums.

66. *Zonotrichia leucophrys gambeli* (Nuttall)

Gambel's Sparrow

A mixed flock of Gambel's and song sparrows stayed in a dense thicket of Russian thistle near our camp in Seward county. They were hard to collect, for if they fell in the thistles it was almost impossible to retrieve them. All of the specimens taken were immature. Gambel's sparrow was not seen in any other locality.

67. *Melospiza melodia beata* Bangs

Mississippi Song Sparrow

One specimen taken in Seward county on November 3 is referred to this subspecies.

68. *Melospiza melodia fallax* (Baird)

Mountain Song Sparrow

Song sparrows were found to be common in every locality except Hamilton and Cheyenne counties. Ten specimens taken are referred to this subspecies, but are not quite typical. However, they are much grayer, and the superciliary stripe is light gray rather than buffy as in other subspecies which could be expected here.

69. *Calcarius lapponicus lapponicus* (Linnaeus)

Lapland Longspur

Apparently we were too early to find the longspurs in large flocks as we had expected to. The only ones seen were flying about with the desert horned larks, and these were found only sparingly. They were more common in Cheyenne county than anywhere else, where they came down to the cornfields. In this locality, neither the longspurs nor the horned larks were found on the uplands. This is probably due to the fact that the weather was so inclement, and the ground was covered with several inches of snow. Several specimens were collected.

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The Pangoniinae of Nearctic America Diptera: Tabanidae*

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Abstract: There are approximately ninety-three species of nearctic Pangoniinae, nearly three fourths of which are Chrysops. The remaining species are distributed through seven genera. Two new genera are described, Stonemyia, to receive a small group of Pangonia and Buplex of authors, and Bequaertomyia, to receive a new leptid-like species from the Pacific coast. Two new subgenera, Pilimas and Comops, are described to receive hairy-eyed species of Stonemyia and Apatolestes, respectively. The genera Silvius, Esenbeckia, Apatolestes and Bequaertomyia are confined to western North America.

The following species and variety are new: *Chrysops beameri, C. bishoppi, C. clavicornis, C. dissimilis, C. hungerfordi, C. latifrons, C. robusta, Silvius laticallus, S. sayi, Apatolestes albipilosus, A. ater, A. comastes willistoni, A. hinei, A. similis,* and *Bequaertomyia anthracina.*

With respect to terminology, the term "vertex" is used to replace "frons" as loosely used by systematists.

The key to Chrysops is based principally on the wing picture. The abdominal pattern is next in importance as a character, and in a few species the shape of the antennae is of value. A small group of Chrysops confined to the west and southwest are peculiar in that the antennae are extremely swollen and in the female the vertex is very broad, in the male the eyes are not absolutely contiguous.

A few male Chrysops are reported for the first time. *C. virgulata* Bell, and with doubt the European *C. lapponica* Loew are reported for the first time as nearctic. The following are new cases of synonymy within the genus Chrysops: *C. lupus* Whit. for *C. furcata* Walk., *C. fraternus* Kröb. for *C. wiedemanni* Kröb., *C. canadensis* Kröb. for *C. frigida* O. S., and *C. moerens confusa* Kröb. for *C. callida* O. S. *C. pertinax* Will. and *C. noctifera* O. S. are distinct species and not synonymous as Hine has stated. The type material of Hine's *C. coquilletti* contains two species, my *C. clavicornis* being represented.

Pangonia dives Will. is preoccupied. The correct name for this species is *Stonemyia* (*Pilimas*) *californica* Big. *Silvius jonesi* Cres. is not a Silvius, but probably a Stonemyia, subgenus Pilimas.

The following species are not included because evidence is lacking or insufficient: *Chrysops cincticornis* Walk., *C. sepulcralis* (Feb.), *Pangonia macroglossa* West., *Corizoneura velutina* Big., and *Ricardoa latiflagrum* End.

NO MONOGRAPHIC studies of North American Tabanidae have been attempted since the classical Prodrome of Osten Sacken (1875-1878). However, Kröber (1926) more or less successfully brought together the North American species of the genus Chrysops; but the unfortunate aspect of this work is that the author lacked sufficient material, and consequently was quite dependent on the literature and the determinations of others for his results. Nevertheless, Kröber's study has contributed materially to the preparation of the present paper. His keys, and especially his observations on the Wiedemann types, have proved useful.

It is the purpose of the author to redescribe all recognizable species of the subfamily Pangoniinae north of Mexico, to attempt to establish more firmly their generic status, and to offer synoptic tables and plates as an aid in identification and separation. Ninety-three species, distributed through eight genera, are included. Fourteen species, one variety, two genera and two subgenera are described as new. In a few instances cases of synonomy have been established.

The literature on the Tabanidae, although not scanty, is for the most part scattered throughout numerous short papers. Hence the need for intensive monographic work is immediately perceived. The literature may be divided into three fields, taxonomic, economic, and biological, although in many instances overlapping must of necessity occur.

Among the outstanding systematic studies in this country are those of Osten Sacken and the many small papers of Hine, and in a more restricted sense, those of Daecke (1905-1907), Malloch (1917), McAtee and Walton (1918), Wehr (1924), Stone (1930), Schwardt and Hall (1930), and Philip (1931). The economic importance of the Tabanidae is too well known to require discussion in this paper. Perhaps the most important contribution in this respect in this country is that of Francis and Mayne (1922) in their work on the transmission of tularaemia by *Chrysops discalis* Will. Also, the investigations of Mitzmain (1913) with respect to the transmission of surra by *Tabanus striatus* Fab., and those of Webb and Wells (1924) must not be overlooked. Not a great deal is known concerning the biology of the Tabanidae; however, various workers have made contributions of a bionomic or strictly biological nature. At present the most complete studies are being made by Dr. H. H. Schwardt at the University of Arkansas. Likewise, Hine (1903 and 1906), Mitzmain (1913), Marchand (1919 and 1920), Webb and Wells (1924), Cameron (1926), Stone (1930), and Philip (1931) have substantially contributed to our knowledge in this field.

To the writer the adults of the Tabanidae are intensely interesting taxonomically, primarily because of their reputed lack of characters. The males, lacking the usual blood-sucking propensities of the females, are poorly represented in collections. It has been suggested to the author several times that he make a study of the abdominal terminalia of the males, but because of lack of material, such an investigation at present would scarcely prove profitable.

Other workers have approached the Tabanidae from this aspect and have failed. Cole (1927) has concluded that the range of variation in the species examined is so slight, that it is doubtful if the characters will in all cases prove of value in taxonomic work.

The author considers the subfamily Pangoniinae, in its broadest sense, to include all species with apical spurs on the hind tibiae, as opposed to the Tabaninae in which these spurs are lacking.

The family Tabanidae of the brachycerous Orthorrapha may be characterized as follows: Bristles lacking; eyes denuded or pilose, in life green or purple iridescent, usually patterned, as a rule, but not always, holoptic in the male and always dichoptic in the female; flagellum of antennae five to eight or nine segmented; wings with an ambient costal vein and a three-branched radial sector; alulae large; empodia pulvilliform; gentalia never prominent.

With respect to morphological terminology the writer has attempted to follow Bromley (1926); however, conditions have arisen where it was necessary to make modifications. It should be noted that the term "vertex" (Pl. XXXVI, fig. 94) has replaced the "front" or "frons" loosely used by systematists, and that "frons" applies to that sclerite just below the antennae, which in the Tabanidae is fused with the clypeus. The Comstock-Needham system of wing venation has been adopted. With respect to the wing picture in the genus Chrysops I follow Osten Sacken and Hine. Any infuscation in the apical region of the wing concolorous with the crossband is considered as the apical spot. It is very difficult to select an appropriate terminology for the abdominal patterns in the genus Chrysops. In speaking of triangles, the apices are always toward the anterior margins of the segments, whereas "trapezoidal spots" have their bases directed anteriorly; in "inverted V-shaped spots" the apices are anterior; by "geminate spot" (Pl. XXXVII, figs. 107, 111, 114) is meant a figure composed of two more or less divergent variously shaped angulate spots more or less broadly joined near the anterior margin of a segment, and it follows that a "double geminate spot" (Pl. XXXVII, figs. 105, 106, 114) implies four spots joined together anteriorly, the median two paired and usually the broader, the outer two paired and usually the narrower, the angles of divergence variable. The "usual stripes" on the thoracic dorsum refers to three brown or fuscous stripes separated by gray or yellow pollinosed stripes, and on the pleurae a brown or fuscous stripe with gray or yellow pruinosity on each side.

CONCERNING THE LITERATURE EMPLOYED

The specific references include original description, synonymy, any additional description, keys, figures and notes of biologic and economic importance. All other references, such as lists, casual notations, and catalogues are excluded, although many of these have been used consistently throughout the work in order to help verify distributional data.

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KEY TO GENERA

1. Flagellum of antenna with five distinct annuli 2
   Flagellum of antenna with eight distinct annuli 4
2. Pedicel of antenna about half as long as the scape .... SILVIUS *Meigen.*
   Pedicel of antenna more than half as long as scape, often nearly as long 3

3. Wings evenly infuscated; abdomen globose, much wider than thorax; antennae very slender and elongate; stump at bifurcation of vein R_{4+5}.
Neochrysops Walton.
Wings irregularly infuscated, exhibiting a variety of patterns (entirely hyaline in *C. hyalina* Shannon); abdomen normal; antennae variable; bifurcation of vein R_{4+5} without a stump (rarely appearing adventitiously).....Chrysops Meigen.
4. Vein 2d A of wing sinuous..................................Bequaertomyia g. n.
Vein 2d A of wing not sinuous.. 5
5. Eyes of female acutely angulate above; anterior portion of wings infuscated.
Goniops *Ald.*
Eyes of female normal; wings of uniform color.................................... 6
6. Palpi short, stubby, about equal in length to proboscis which is conspicuously shorter than head ....Apatolestes Will.
Palpi slender, distinctly shorter than proboscis which is often as long as or longer than head 7
7. Cell R_5 petiolate.......................................Esenbeckia Rond.
Cell R_5 open...Stonemyia g. n.

Chrysops Meigen (1803)

1803. *Chrysops* Meigen, Illiger's Mag., II, 267.
1823. *Chrysopsis* Duméril, Consider. Gener. Classif. Insectes, 227.
1856. *Nemorius* Rondani, Prodrom. Dipt. Ital., I, 171.
1873. *Haemophila* Kriechbaumer, Verh. Zoöl. Bot. Ges. Wien., XXIII, 70.
1882. *Haematophila* Verrall, in Scudder, Nom. Zoöl., I, 152.
1920. *Heterochrysops* Kröber, Zoöl. Jahrb., Abt. Syst., XLIII, 1-4, pp. 50 and 55.
1922. *Neochrysops Szilady,* Ann. Mus. Nat. Hungarici, XIX, 126 (nec. Walton).
1923. *Ziemannia* Enderlein, Deutsche Ent. Ztsch., p. 544.
1923. *Kleineana* Enderlein, Deutsch Ent. Ztsch., p. 544.
1926. *Psylochrysops* Szilady, Zoöl. Anz., LXVI, 328.
1926. *Turanochrysops* Stackelberg, Bull. Ent. Res., XVI, 4, p. 326.

Genotype. Tabanus caecutiens Linnaeus, 1758.

Generic Characters. Eyes denuded, in life green iridescent with a purple pattern, separated in the female, contiguous in the male; ocelli present; the female with a frontal callus; frontoclypeus prominent; antennae slender or swollen, the flagellum five-segmented, sometimes the long basal segment appears more or less annulated, pedicel more than half as long as the scape; proboscis about equal to the length of the head or shorter; palpi more or less lanceolate, about three fourths the length of the proboscis. Wings usually with an infuscated picture. Flies relatively small, rarely exceeding twelve millimeters. Perhaps more variation is exhibited in the dorsal abdominal patterns than in any other group of the Tabanidae.

Specific Characters. The key is based primarily upon the wing picture. At present this affords the most satisfactory character that may be applied to the whole group within our fauna. Next in importance is the dorsal abdominal pattern, although this character must always be used in connection with others. A most valuable character in some forms is to be found in the shape of the antennae and width of the vertex, but unfortunately this has proved applicable to less than a dozen species. It may be well to point out here that there are in North America two very distinct groups as based upon structural characters. One group, principally western and southwestern in distribution, numbering but eight species, has distinctly incrassate antennae and in the female the vertex is at least as broad as long, usually broader; it appears that in studying the males of this group, the eyes are not absolutely contiguous, in the strict sense of the word, but are separated by a very narrow space; however, this is true in the case of some males of the other group. In the other group the antennae for the most part are relatively slender (exception, *C. brunnea* Hine) and in the female the vertex is longer than broad, and the eyes of the male are typically contiguous. In this latter group are included the majority of our species. Another character of importance is the frontoclypeus and its color.

Because of the frequent sexual dimorphism exhibited by this genus and because, unfortunately, all of the males are not yet known, it is necessary to construct a key for each sex. The typical wing picture of every female has been figured, consequently this character is not dwelled upon at any length in the descriptions.

KEY TO FEMALES

1. Wings hyaline .... *hyalina* Shan., p. 308
   Wings pictured 2
2. Apex of wing beyond crossband hyaline, sometimes just a trace of a cloud 3
   Apex of wing beyond crossband infuscated 12
3. Whole wing infuscated to distal margin of crossband, more dilute in anal area .... *divisa* Walker, p. 289
   Whole wing not infuscated to distal margin of crossband 4
4. Cell 2d M hyaline 5
   Cell 2d M infuscated, as a rule for at least half its area, often more 7
5. Abdominal pattern a contrast of yellow and fuscous; cell R hyaline; crossband of wing very faint .... *fulvistigma* Hine, p. 300
   Abdomen black or fuscous; cell R partially or wholly infuscated 6
6. Crossband of wing saturate black; abdomen black .... *nigra* Macq., p. 318
   Crossband of wing faint, light brown; abdomen fuscous .... *nigribimbo* Whit., p. 319
7. (4) Pile of pleurae yellow or orange 8
   Pile of pleurae, and usually of cheeks and dorsum of thorax whitish to gray 10
8. Abdomen typically black, although rather indistinct grayish middorsal triangles may sometimes be seen; pleurae densely golden-yellow pilose .... *celer* O. S., p. 275
   Abdomen black, the sides of the anterodorsal region encroached upon by yellow, of variable extent; pile of pleurae pale yellow 9
9. Posterior margins of abdominal segments conspicuously gray; grayish-yellow lateral spots confined to small area .... *sordida* O. S., p. 340
   Posterior margins of abdominal segments not gray; yellow lateral spots of greater extent; yellow or grayish-yellow middorsal triangles frequently present. *excitans* Walker, p. 290
10. (7) Wing picture dilute, especially the crossband; cell 1st A hyaline; the black of the abdomen invaded dorsolaterally on segments I and II by a yellowish-gray spot .... *cuclux* Whit., p. 281
   Wing picture saturate; cell 1st A partially infuscated at apex; the black of the abdomen not encroached upon by lateral spots 11

11. Base of cell Cu_1 hyaline ... *carbonaria* Walker, p. 274
Base of cell Cu_1 infuscated; large obscure gray middorsal triangles more likely to be present; generally larger species ... *mitis* O. S., p. 314
12. (2) Apical spot of the wing usually rather narrow, at the most including only the extreme apex of cell R_4 ... 13
Apical spot of the wing generally broad, of greater extent, including as a rule at least half of cell R_4 and often attaining cell M_1 ... 27
13. A tooth-like projection from the distal margin of the crossband extending into cell R_3 almost attaining the bifurcation of vein R_{4+5} ... *nigripes* Zetter., p. 320
Distal margin of crossband relatively regular ... 14
14. Scape of antenna distinctly more swollen than pedicel ... *dissimilis* n. sp., p. 288
Scape of antenna not swollen more than pedicel ... 15
15. Cell R completely infuscated, cells 2d M and Cu_1 hyaline ... 16
Cell R hyaline, or but partly infuscated; if the former, then cell 2d M is hyaline; if the latter, then cell 2d M is partly infuscated; cell Cu_1 usually shows some infuscation ... 18
16. Small grayish black eastern species ... *brimleyi* Hine, p. 268
Species with abdomen distinctly patterned in yellow and black; western species .. 17
17. Frontoclypeus with a very narrow denuded yellow longitudinal stripe .. *surda* O. S., p. 342
Frontoclypeus with a broad denuded yellow longitudinal stripe ... *proclivis* O. S., p. 330
18. (15) Abdomen wholly black ... *pertinax* Will., p. 327
Abdomen not wholly black ... 19
19. Apex of hyaline triangle usually exceeds vein R_{2+3}; cell R infuscated for about half its area ... 20
Apex of hyaline triangle rarely exceeds vein R_{2+3}; greatest portion of cell R hyaline ... 22
20. Abdomen predominantly black, on each side of the anterodorsal region a yellow spot ... *noctifera* O. S., p. 321
Abdomen yellow in ground color with a black pattern ... 21
21. Wing picture dilute; oral margins of genae yellow; front and hind femora yellow ... *bishoppi* n. sp., p. 266
Wing picture saturate; oral margins of genae black; front and most of hind femora black ... *furcata* Walker, p. 301
22. (19) Frontal callus usually yellow; apical spot of the wing at its base extending into cell R_3 ... 23
Frontal callus black; apical spot narrow, at its base not extending into cell R_3 ... 25
23. Length, 8 mm. to 10 mm.; the black figure of the second abdominal segment practically joins with that of the first ... *sackeni* Hine, p. 335
Length rarely exceeds 8 mm., the black figure of the second abdominal segment does not join with that of the first ... 24
24. Pale species; hind femora yellow; crossband dilute; black abdominal figures faint; no black spot beneath the scutellum ... *cursim* Whit., p. 282
Darker species; hind femora fuscous, at least basal portions; crossband saturate; black abdominal figures more conspicuous; usually a black spot beneath the scutellum ... *pudica* O. S., p. 332
25. (22) Crossband dilute, not attaining posterior margin of wing ... *delicatula* O. S., p. 283
Crossband saturate, usually attaining posterior margin of wing ... 26
26. A black triangle encroaches upon the yellow or gray on each side of the central spot on the second abdominal segment; vertex little convergent posteriorly; apex of cell M_3 often hyaline ... *aestuans* Wulp, p. 261
As a rule no black triangle encroaches upon the yellow on each side of the central spot on the second abdominal segment; vertex more convergent posteriorly; cell M_3 usually entirely infuscated ... *callida* O. S., p. 271
27. (12) Cell R completely infuscated, rarely a small subhyaline spot near its apex; antennae slender, never swollen ... 28
Cell R not completely infuscated, usually not more than half, sometimes almost entirely hyaline; antennae variable, slender to extremely robust ... 47
28. Hyaline triangle represented by a hyaline spot occupying mostly the center of cell R_3 ... *bistellata* Daecke, p. 267
Hyaline triangle otherwise represented, always open to the posterior margin of the wing ... 29

29\. Crossband broken by dilute areas along the margins of the veins. . *shermani* Hine, p. 338

Crossband evenly saturate throughout. 30

30\. Apex of hyaline triangle not extending beyond vein M_1. . . . . *moecha* O. S., p. 315

Apex of hyaline triangle extending beyond M_1. 31

31\. Wholly black species; legs black. . . . . *separata* Hine, p. 336

Not wholly black species; legs variable, usually showing some yellow or brown. . . 32

32\. Abdomen with no conspicuous pattern; usually fuscous or black (indistinct yellow stripes sometimes visible). 33

Abdomen conspicuously patterned in yellow and black. 37

33\. Front coxae brown to black; wing picture fuliginous, a rather prominent spot at the bifurcation of vein $R_4 + {}_5$, sometimes formed by a continuation of the distal margin of the crossband. . . . . *fuliginosa* Wied., p. 297

Front coxae yellow; wing picture brown to dark brown; no spot at bifurcation of vein $R_4 + {}_5$ *34

34\. Hyaline triangle of the wing quite narrow, crescent shaped, open usually to vein $R_2 + {}_3$; cubital and anal areas frequently dilutely infuscated. 35

Hyaline triangle of the wing more broadly open at its base, the apex not usually attaining vein $R_2 + {}_3$; cubital and anal areas hyaline. 36

35\. Dorsum of abdomen with three more or less obsolete yellow stripes; pleurae and thoracic stripes yellow pollinose. . . . . *obsoleta* Wied., p. 322

Dorsum of abdomen entirely fuscous, sometimes a trace of a pale middorsal stripe; pleural and thoracic stripes gray pollinose. *ultima* Whit., p. 343

36\. Hind femora and tibiae predominantly fuscous; dorsum of abdomen entirely fuscous; length 5.5 mm. to 7 mm. . . . . *parvula* Daecke, p. 326

Hind femora and tibiae predominantly yellow; dorsum of abdomen fuscous, frequently with a faint gray middorsal stripe; length 6.5 mm. to 8.5 mm. *lugens* Wied., p. 313

37\. (32) Abdomen with a broad black middorsal stripe. . . . . *dorsovittata* Hine, p. 290

Abdomen with no black middorsal stripe. 38

38\. The yellow of the abdomen with four more or less complete brown or black longitudinal stripes 39

The yellow of the abdomen not with four longitudinal stripes. 45

39\. Apex of hyaline triangle extending considerably beyond vein $R_4 + {}_5$, usually attaining at least vein $R_2 + {}_3$, often vein R_1. 40

Apex of hyaline triangle extending but very little beyond vein $R_4 + {}_5$. 43

40\. Lateral abdominal stripes incomplete, not appearing on segments I and II. *pikei* Whit., p. 328

Lateral abdominal stripes complete. 41

41\. Frontal callus black. . . . . *sequax* Will., p. 337

Frontal callus yellow. 42

42\. Apical spot extending but little into cell R_5; hyaline triangle broad at base. *beameri* n. sp., p. 265

Apical spot typically extending deep into cell R_5, often into M_1; hyaline triangle narrow at base. . . . . *hinei* Daecke, p. 305

43\. (39) Ground color of dorsum of thorax plumbeus; at least disc of scutellum brown or plumbeus; frontal callus variable, black to yellow. . . . . *striata* O. S., p. 341

Ground color of dorsum of thorax yellow; scutellum yellow; frontal callus always yellow 44

44\. Abdominal stripes obsolete, brown, the lateral stripes scarcely at all represented on segments I and II; apical spot of the wing extending into cell R_5. *vittata* Wied. var. *floridana* John., p. 348

Abdominal stripes conspicuous, black; apical spot of the wing broken or ceasing entirely before entering cell R_5. . . . . *vittata* Wied., p. 347

45\. (38) Fourth abdominal segment with a fuscous cruciform spot. . . . *ornata* Kröber, p. 324

Fourth abdominal segment not with a fuscous cruciform spot. 46

46\. Apical spot exceeds vein R_5; abdomen with a broad yellow middorsal stripe between two black ones. . . . . *univittata* Macq., p. 344

Apical spot not exceeding vein R_5; abdomen not so marked. . . . . *inda* O. S., p. 309

47\. (27) Antennae distinctly swollen, at least the scape. 48

Antennae not distinctly swollen, often quite slender. 58

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* The characters used for separating the species of this group are to be applied with considerable caution.

48. Vertex broader than long, or at least as broad as long........................ 49
Vertex longer than broad.. 57
49. First segment of flagellum distinctly longer than the sum of the four apical segments .... *virgulata* Bell., p. 345
First segment of flagellum not longer than the sum of the four apical segments... 50
50. Apical spot of the wing not exceeding vein R_5, as a rule occupying about half of cell R_4 51
Apical spot of the wing exceeds vein R_5.. 56
51. Discal cell typically hyaline; a tooth-like projection extends from the distal margin of the crossband into cell R_3 attaining the bifurcation of vein $R_4 + {}_5$. *latifrons* n. sp., p. 312
Discal cell usually infuscated; no tooth-like projection, etc................... 52
52. Frontoclypeus and oral margins of genae with black spots; antennae moderately incrassate .... *facialis* Towns., p. 292
Frontoclypeus and oral margins of genae pure yellow; antennae strongly incrassate, 53
53. Second abdominal tergite with a double geminate black spot......*robusta* n. sp., p. 333
Second abdominal tergite not with a double geminate black spot................ 54
54. Scape of antenna much more swollen than pedicel (Pl. XXXV, fig. 84); robust species .... *coquilletti* Hine, p. 279
Scape of antenna not much more swollen than pedicel (Pl. XXXV, fig. 91); smaller species 55
55. Abdominal tergites caudad from III with black lateral spots...*hungerfordi* n. sp., p. 306
Abdominal tergites caudad from III without black lateral spots...*pachycera* Will., p. 324
56. (50) Cell 1st M_2 with a dilute fenestrate spot; scape of antenna not bottle-shaped .... *fulvastra* O. S., p. 298
Cell 1st M_2 infuscated to the same degree as the rest of the crossband; scape of antenna bottle-shaped .... *clavicornis* n. sp., p. 277
57. (48) Abdomen light brown, pattern obscure; scape and pedicel of antenna prominently swollen; apical spot of wing fades out to hind margin...*brunnea* Hine, p. 270
Abdomen more yellowish, pattern distinct; scape and pedicel of antenna not so markedly swollen; apical spot of wing ceases abruptly in cell R_4. *flavida* Wied., p. 293
58. (47) Discal cell hyaline, a conspicuous infuscated spot at bifurcation of vein $R_4 + {}_5$ .... *discalis* Will., p. 286
Discal cell infuscated, no spot at bifurcation of vein $R_4 + {}_5$.................... 59
59. Black species; pleurae densely fulvous pilose..................*amazon* Daecke, p. 263
Not black species; pile of pleurae variable; abdomen patterned in yellow and black 60
60. Abdomen typically fuscous or black with a conspicuous yellow middorsal stripe, sometimes on each side of which appears an obsolete stripe of the same color. *wiedemanni* Kröber, p. 348
Abdomen not so patterned, the yellow ground color usually very conspicuous, but not always predominant.. 61
61. Apex of hyaline triangle distinctly exceeds vein $R_2 + {}_3$, often attaining vein R_1.. 62
Apex of hyaline triangle not exceeding vein $R_2 + {}_3$, often not even attaining this vein 65
62. Frontal callus yellow, at least on the disc..................*coloradensis* Bigot, p. 278
Frontal callus black.. 63
63. Second abdominal segment pure yellow....*geminata* Wied. var. *impuncta* Kröber, p. 304
Second abdominal segment with two median divergent black spots.............. 64
64. Crossband reaches the posterior margin of the wing; apical spot occupies nearly the whole of cell R_4; geminate spots on second abdominal segment do not usually attain posterior margin..............................*geminata* Wied., p. 303
Crossband not typically reaching posterior margin of the wing; apical spot occupies about a half of cell R_4; geminate spots on second abdominal segment usually attain the posterior margin..............................*lateralis* Wied., p. 310
65. (61) Frontoclypeus black, only the pollinosed areas yellow.........*frigida* O. S., p. 295
Frontoclypeus yellow, denuded.. 66
66. Hind femora entirely yellow; frontal callus always yellow; spot beneath scutellum absent or obsolete.. 67
Hind femora not entirely yellow; frontal callus variable, often black; conspicuous black spot beneath the scutellum.. 68

67. Ground color of thoracic dorsum and scutellum typically yellow; crossband of wing saturate .... *flavida* Wied., p. 293

Ground color of thoracic dorsum and scutellum not yellow; crossband of wing dilute .... *cursim* Whit., p. 282

68. Second abdominal tergite with a small black spot on each side of the median figure, tergites III and IV each with four black spots.......... *montana* O. S., p. 316

Second abdominal tergite not with a small black spot on each side of the median figure, tergites III and IV predominantly black with narrow yellow hind margins which expand into middorsal triangles.......... 69

69. Hind femora and tibiae predominantly black; frontal callus usually black; the black median figure on the second abdominal tergite usually attains the anterior margin .... *dimmocki* Hine, p. 284

Hind femora and tibiae predominantly yellow; frontal callus usually yellow; the black median figure on the second abdominal tergite does not attain the anterior margin .... *pudica* O. S., p. 332

KEY TO MALES

1. Apex of the wing beyond the crossband hyaline (apical spot absent).......... 2

Apex of the wing beyond the crossband more or less infuscated (apical spot present) 9

2. Dorsum of abdomen at base encroached upon laterally by gray.......... *cuclux* Whit., p. 281

Dorsum of abdomen otherwise.......... 3

3. Crossband of wing light brown, very dilute, almost obsolete.......... 4

Crossband of wing fuscous, saturate.......... 5

4. Dorsum of abdomen a contrast of yellow and fuscous.......... *fulvistigma* Hine, p. 300

Dorsum of abdomen wholly fuscous.......... *nigribimbo* Whit., p. 319

5. Frontoclypeus yellow except for a fuscous spot on each side.......... *nigra* Macq., p. 318

Frontoclypeus black 6

6. Base of cell Cu$_1$ typically with a hyaline spot.......... *carbonaria* Walker, p. 274

Base of cell Cu$_1$ infuscated.......... 7

7. Dorsum of abdomen with some yellowish pubescence, especially near the apex and forming median triangles.......... *excitans* Walker, p. 290

Dorsum of abdomen black pubescent.......... 8

8. Crossband attaining posterior margin of wing; antennae wholly black.. *celer* O. S., p. 275

Crossband not attaining posterior margin of wing; antennae not wholly black. *mitis* O. S., p. 314

9. (1) Apical spot approximately the same width for its entire length, including only the apex of cell R$_4$.......... 10

Apical spot not as above, variable, usually including at least half of cell R$_4$, often extending considerably beyond.......... 18

10. Scape of antenna distinctly more swollen than pedicel.......... *dissimilis* n. sp., p. 288

Scape of antenna not more swollen than pedicel.......... 11

11. A tooth-like projection from the distal margin of the crossband extending into cell R$_3$ practically attaining the bifurcation of vein $R_4 + {}_5$.... *nigripes* Zetter., p. 320

No tooth-like projection from the distal margin of the crossband, etc.......... 12

12. Wholly black species; frontoclypeus black; apical spot practically separated from the crossband.......... *pertinax* Will., p. 327

Not wholly black species; frontoclypeus yellow; apical spot distinctly united with the crossband 13

13. Apical spot at its base distinctly exceeding vein $R_2 + {}_3$.......... *sackeni* Hine, p. 335

Apical spot at its base not exceeding vein $R_2 + {}_3$.......... 14

14. Frontoclypeus and oral margins of genae entirely yellow.......... 15

Frontoclypeus and oral margins of genae not entirely yellow, usually with a black spot on each side.......... 17

15. Wing picture dilute.......... *bishoppi* n. sp., p. 266

Wing picture saturate.......... 16

16. Antennae black, the yellow of the second abdominal tergite encroached upon posterolaterally by a black triangle.......... *aestuans* Wulp, p. 261

Antennae mostly yellow; as a rule no posterolateral black triangle encroaches upon the yellow of the second abdominal tergite.......... *callida* O. S., p. 271

17. Frontoclypeus black with a narrow yellow midstreak ... *surda* O. S., p. 342
Frontoclypeus yellow with a black spot on each side ... *proclivis* O. S., p. 330
18. (9) Antennae incrassate ... 19
Antennae not incrassate ... 28
19. Eyes contiguous; light brown species ... *brunnea* Hine, p. 270
Eyes separated, often very narrowly, but nevertheless, distinctly; species not light brown ... 20
20. Annulate portion of flagellum much shorter than basal segment ... *virgulata* Bell., p. 345
Annulate portion of flagellum not shorter than basal segment, usually longer ... 21
21. Apical spot of the wing extending beyond vein R_5 ... 22
Apical spot of the wing not extending beyond vein R_5, usually not even attaining this vein ... 23
22. Antennae yellowish, the scape distinctly bottle-shaped; second abdominal tergite yellow with a median broad black geminate figure and a black spot on each side ... *clavicornis* n. sp., p. 277
Antennae black, the scape not bottle-shaped; second abdominal tergite not patterned as above ... *fulvastra* O. S., p. 298
23. A tooth-like projection from the distal margin of the crossband extending into cell R_3 to the bifurcation of vein R_{4+5} ... *latifrons* n. sp., p. 312
No tooth-like projection from the distal margin of the crossband ... 24
24. Second abdominal tergite with a double black geminate figure ... *robusta* n. sp., p. 333
Second abdominal tergite not with a double black geminate figure ... 25
25. Frontoclypeus yellow with a row of four black spots across the disc. *facialis* Towns., p. 292
Frontoclypeus wholly yellow ... 26
26. Second abdominal tergite with black lateral spots ... *hungerfordi* n. sp., p. 306
Second abdominal tergite without black lateral spots ... 27
27. Cell 2d M infuscated subequally with R; crossband sometimes fenestrate; abdominal tergites III and IV rarely with a black spot on each side. *pachycera* Will., p. 324
Cell 2d M infuscated about one half that of R; crossband never fenestrate; abdominal tergites III and IV always with a black spot on each side. *coquilletti* Hine, p. 279
28. (18) Discal cell (1st M_2) hyaline ... *discalis* Will., p. 286
Discal cell infuscated ... 29
29. Apical spot includes practically all of cell R_4, often extending beyond vein R_5 ... 30
Apical spot not including all of cell R_4, never attaining vein R_5 ... 39
30. Apex of hyaline triangle not extending beyond vein M_1 ... *moecha* O. S., p. 315
Apex of hyaline triangle extending beyond vein M_1 often as far as the costal margin ... 31
31. Apex of hyaline triangle distinctly extending beyond vein R_{4+5}, usually attaining vein R_{2+3}, and sometimes exceeding it ... 37
Apex of hyaline triangle not extending beyond vein R_{4+5}, but sometimes a small hyaline spot at its bifurcation ... 36
32. Conspicuous yellow and black species ... 33
Not conspicuous yellow and black species ... 36
33. Dorsum of abdomen vittate (four black stripes); apex of hyaline triangle not exceeding vein R_{2+3} ... 34
Dorsum of abdomen not vittate; apex of hyaline triangle attains vein R_1 ... 35
34. Lateral abdominal stripes incomplete; cells 2d M and Cu_1 mostly hyaline; hyaline triangle broadly open ... *pikei* Whit., p. 328
Lateral abdominal stripes complete; cells 2d M and Cu_1 considerably infuscated; hyaline triangle narrow ... *sequax* Will., p. 337
35. Second abdominal tergite yellow with two median divergent black spots. *geminata* Wied., p. 303
Second abdominal tergite completely yellow ... *geminata impuncta* Kröber, p. 304
36. Dorsum of abdomen wholly fuscous ... *lugens* Wied., p. 313
Dorsum of abdomen fuscous with three indistinct yellow stripes ... *obsoleta* Wied., p. 322
37. (31) Dorsum of abdomen predominantly fuscous with a trace of yellow on the sides and a conspicuous yellow median stripe ... *univittata* Macq., p. 344
Dorsum of abdomen predominantly yellow with four more or less complete black stripes ... 38

38. Ground color of thoracic dorsum and scutellum yellow..........*vittata* Wied., p. 347
Ground color of thoracic dorsum and scutellum plumbeus..........*striata* O. S., p. 341

39. (29) Body entirely fuscous or black (including antennae, palpi and greater portions of the legs).......... 40
Body not entirely fuscous or black.......... 42

40. Apical spot narrowly joined to the crossband; an infuscated spot at the bifurcation of vein R_{4+5}..........*fuliginosa* Wied., p. 297
Apical spot separated from the crossband; no infuscated spot at the bifurcation of vein R_{4+5}.......... 41

41. Wing practically entirely infuscated to the distal margin of the crossband; a small hyaline spot at the apices of cells R and 2d M..........*separata* Hine, p. 336
Wing not entirely infuscated to the distal margin of the crossband; the hyaline areas of cells R and 2d M appear as a single band near their apices extending from vein R_{2+3} to Cu_1..........*amazon* Daecke, p. 263

42. (39) Frontoclypeus and oral margins of genae entirely yellow.......... 43
Frontoclypeus and oral margins of genae with a large black spot on each side... 49

43. Cells R and 2d M predominantly hyaline; dorsum of abdomen pale yellow with light brown or fuscous markings; second tergite with an inverted V-shaped median spot not reaching the anterior margin.......... 44
Cells R and 2d M predominantly infuscated; dorsum of abdomen not as above, often predominantly black.......... 46

44. Ground color of thoracic dorsum and scutellum typically yellow; abdominal figures usually light brown..........*flavida* Wied., p. 293
Ground color of thoracic dorsum and scutellum green gray; abdominal figures usually black.......... 45

45. Basal portion of hind femora black..........*pudica* O. S., p. 332
Hind femora mostly yellow..........*cursim* Whit., p. 282

46. Dorsal abdominal pattern more or less vittate; the second tergite with a narrow black spot on each side of the black median geminate figure...*montana* O. S., p. 316
Dorsal abdominal pattern not vittate; no black spot on the sides of the second tergite.......... 47

47. The apical spot at its base not reaching the bifurcation of vein R_{4+5}; hind femora black..........*dimmocki* Hine, p. 284
The apical spot at its base practically attains the bifurcation of vein R_{4+5}; apical portion of hind femora yellow.......... 48

48. Sides of abdominal tergites II to IV broadly incised with yellow..*pilumna* Kröber, p. 329
Sides of abdominal tergites II to IV very narrowly incised with yellow..*inda* O. S., p. 309

49. (42) Apex of hyaline triangle not attaining vein R_{2+3}..........*frigida* O. S., p. 295
Apex of hyaline triangle distinctly exceeds vein R_{2+3}.......... 50

50. Abdominal pattern vittate.......... 51
Abdominal pattern not vittate..........*coloradensis* Bigot, p. 278

51. Dorsum of abdomen fuscous with a conspicuous yellow median stripe. *wiedemanni* Kröber, p. 348
Dorsum of abdomen not as above.......... 52

52. Dorsum of abdomen yellow with a broad black median stripe...*dorsovittata* Hine, p. 290
Dorsum of abdomen yellow with a series of black vittate spots (two on the second tergite, four on tergites III and IV, etc.)..........*lateralis* Wied., p. 310

Chrysops aestuans Van der Wulp (1867)

(Plate XXXI, fig. 35)

1867. *C. aestuans* Van der Wulp, Tijdsch. v. Ent., X, 135; pl. III, f. 8, 9.
1875. *C. aestuans* Osten Sacken, Prodrome, I, 378.
1895. *C. aestuans* Hart, Bull. Ill. State Lab. N. H., IV, 227.
1897. *C. aestuans* Lugger, 2d Rept. Ent. Minn., p. 169, fig.
1901. *C. aestuans* Hine, Ohio Nat., II, 168.
1931. *C. aestuans* Philip, Minn. Tech. Bull. LXXX, p. 82.

The following also refer to this species:

1848. *C. moerens* Walker, List, I, 201 (preoc.).
1903. *C. moerens* Hine, Ohio State Acad. Sci. Spec. Pap. No. 5, p. 40.

1906. *C. moerens* Hine, Tech. Ser., Bur. Ent. Bull. 12, pt. II, 36-38.
1920. *C. moerens* Marchand, Mon. Rock. Inst., No. 13, p. 50.
1924. *C. moerens* Wehr, Neb. Univ. Studies XXII, 112.
1926. *C. moerens* Cameron, Bull. Ent. Res., XVII, 23.
1926. *C. moerens* Kröber, Stett. Ent. Ztg., LXXXVII, 280.

Color. Predominantly black with grayish or yellow markings on the abdomen.

Size. Length, 7 mm. to 10 mm.

Structural and Color Characters. Female: A most variable species. Vertex and sides of genae gray to yellowish pollinose. Frontal callus black; frontoclypeus, genae, and palpi orange-yellow. Antennae variable, the ground color orange-yellow; scape and pedicel with black pubescence; flagellum black apically. Thoracic dorsum and scutellum gray to yellow-gray pollinose, the former with rather broad stripes; pleural and sternal regions pollinose with some black showing through. Dorsum of abdomen with a broad, black spot beneath the scutellum practically reaching a heavy geminate black figure on the second segment which usually, following along the posterior margin on each side, expands again as a black triangle on the yellow or grayish ground color of the segment; remaining segments black, the yellow or gray posterior margins expanding into middorsal triangles. Venter of abdomen variable; frequently dark at the base, usually a broad black median stripe, broken at the margin of the segments; apical segments and a narrow lateral streak, black; elsewhere yellowish or gray. Wings as figured; as a rule cell M_3 is hyaline at the apex and the apical spot at its base often does not attain vein R_{2+3}, however, both of these characters vary. Legs variable; in those forms in which a gray color prevails rather than yellow and the venter of the abdomen exhibits more dark figuration than pale, the front coxae and the greater portions of all the legs are black; where yellow has dominance over the gray, and occupies considerable space on the venter of the abdomen, the front coxae and legs are predominantly yellow. In the first case, yellow appears at the base of the tibiae and middle and hind tarsi; in the second case black appears at the joints, the apex of the front femora, tibiae, and entire tarsi, and the extreme apical portions of the median and posterior tibiae and tarsi. But, as indicated before, for such a variable species these characters will have to be applied with caution. Male: Considerably darker than the female. In some specimens the antennae and palpi are practically black. Thorax and abdomen like the female except for the greater dominance of black, confining the yellow or gray to smaller areas. Cells R and 2d M of the wings infuscated except for a small hyaline area near their apices. Legs mostly black, except the usual lighter regions. The male exhibits much more pilosity than the female.

Comparative Notes. Closely related to *C. callida* O. S. To be separated according to the key. Large series of both these species show such variation and intergradation that a point is reached where separation becomes extremely difficult. Distributional data would seem to indicate that *C. aestuans* is mostly confined to the North and Northwest. On the other hand, *C. callida* has a wider range, especially in its southern distribution. In the males, the apical spot of *C. aestuans* is narrower than in *C. callida,* and I have never seen a male of the latter with black antennae and palpi; also the male of *C. callida* shows a greater extent of yellow on the venter of the abdomen and legs.

Remarks. The above description is based mostly on specimens compared with the types of Walker's *C. moerens.* There is no doubt as regards their identity. As Philip (1931) pointed out, this name must fall since it is preoccupied by a *C. moerens* (Tabanus) of Fabricius (1794); therefore *C. aestuans* Van der Wulp becomes valid.

*Distributional Data:**

Canada: Ontario 1, June 23.

United States: New York 2, July 4 - Aug. 8; Michigan 3, July 2 - Aug. 8; Ohio 3, June 9; Indiana 2, July 9; Illinois 5, June 6 - Aug. 24; Minnesota 2, June 16 - July 15; North Dakota 1, June 16; South Dakota 4, June 28 - July 8; Kansas 4, June; Colorado 3, Aug. 9 - Aug. 27; Idaho 1; Utah 5, June 25 - July 7; Washington 4, June - July 13.

In addition, reported by others from:

Canada: Manitoba, Saskatchewan, British Columbia.

United States: Wisconsin, Nebraska, Oregon.

Chrysops amazon Daecke (1905)

(Plate XXXIII, fig. 61)

1905. *C. amazon* Daecke, Ent. News, XVI, 250, fig.
1907. *C. amazon* Daecke, Ent. News, XVIII, 140.
1926. *C. amazon* Kröber, Stett. Ent. Ztg., LXXXVII, 305.

Color. Predominantly black with short, white pubescence; dense fulvous pile on the pleurae.

Size. Length, 9 mm. to 11 mm.

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* In order to save space I have condensed the distributional data from the original MS. The number immediately following province, state, territory, or district represents the number of different specific localities from which I have records. The dates represent earliest and latest collecting dates.

Structural and Color Characters. Female: Vertex, frons, sides of genae and a mid-streak on the frontoclypeus grayish pollinose. Frontal callus, ocellar area, remaining portions of frontoclypeus and genae, and the palpi fuscous to black. Antennae very slender; the scape and pedicel brownish-yellow, flagellum black apically. Dorsum of thorax and scutellum black with white pubescense, the former with two obscure, gray pruinose stripes, pleurae and thoracic venter black with some gray pruinosity, the former with conspicuous dense fulvous or orange pile. Abdomen entirely black or fuscous with sparse white pubescence. Wings as figured. Halteres black. Legs black; the base of the median and posterior tarsi light brown, the median tibiae also are somewhat lighter at the base. Male: Wholly black, with black pubescence and pilosity. Wing picture similar to the female except for a greater extent of infuscation in cells R and 2d M, leaving but a small hyaline space near their apices.

Comparative Notes. Besides *C. celer* O. S. this is the only other species included within the scope of this paper which has heavy orange pile on the pleurae. It is easily separated by the presence of an apical spot on the wing. Daecke (1905) relates *C. amazon* to *C. noctifera* O. S., from this species it will be readily distinguished by the pile on the pleurae, greater extent of the crossband and apical spot and absence of triangles on the abdomen.

Remarks. In the key I have placed this species with the group in which the apical spot of the wing includes more than just the apex of cell R_4. A casual observation will no doubt give rise to dispute, but since the apical spot fades away into cell R_4 and beyond, until the eye cannot tell where the infuscation stops and the hyaline area begins, I feel justified in assigning *C. amazon* to the group mentioned above.

Type Data. I have studied the cotypes in the United States National Museum. According to Kröber (1926) there is one cotype in the Museum of Ottawa. Described from four females, all from Browns Mills Junction, New Jersey.

Distributional Data:

UNITED STATES: New Jersey: Browns Mills Junction, June 24, 1906.

In addition, reported by others from:

UNITED STATES: Massachusetts, New Hampshire.

Chrysops beameri, new species

(Plate XXIX, fig. 2; Plate XXXII, fig. 40; Plate XXXV, fig. 86)

Color. Yellow, with fuscous stripes on the dorsum of thorax and abdomen.

Size. Length, 8 mm.

Structural and Color Characters. Female: Frontal callus, frontoclypeus, genae and palpi yellow; the usual areas with yellow pollen; ocellar area stained brown. Antennae very slender, the flagellum thicker than the scape; scape and pedicel yellow with a few black hairs, flagellum mostly black. Dorsum of thorax, pleural and sternal regions yellowish pollinose with fuscous stripes, the median stripe of the thoracic dorsum often continues on to the yellow scutellum. Dorsum of abdomen yellow with four fuscous longitudinal stripes; venter of abdomen yellow with a broad, midventral, brown stripe extending basally not beyond segment II, on each side a narrow stripe. Wings as figured. Legs predominantly yellow. Apical portion of front tibiae and entire tarsi, base of middle and hind femora and apical tarsal segments brown.

Comparative Notes. This species would fall in Kröber's so-called "Gruppe: vittatus." The hyaline triangle of the wings resembles that of *C. sequax* Will., but from this *C. beameri* differs by its yellow callus and scutellum. It may be separated from *C. pikei* Whit. by the complete lateral abdominal stripes, the greater extent of the hyaline triangle, and also by the yellow callus. From *C. hinei* Daecke it is distinguished by the hyaline triangle being broadly open at its base, cell Cu_1 hyaline, and the more pronounced yellow of the dorsum of the thorax and scutellum.

Type Data. Holotype, female; Comanche Co., Kansas; 2,089 feet, 1916, R. H. Beamer. Paratypes, eleven females; same data. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

Remarks. Since describing this species I have seen several other specimens in the National Museum which appear to be *C. beameri*. One female from Woods Hole, Mass., Aug., 1920, by Leland Wood, and five females from Washington, D. C., Aug. 19, 1911, by Frederick Knab.

Chrysops bishoppi, new species

(Plate XXXI, fig. 26; Plate XXXVII, fig. 107)

Color. Yellow with black abdominal pattern; wing picture dilute.

Size. Length, 8 mm. to 10 mm.

Structural and Color Characters. Female: Vertex, frons and sides of genae yellow pollinose; frontal callus black; frontoclypeus and oral margins of genae denuded yellow; the pits on each side of the frontoclypeus and a tiny spot on the outer side of the oral margins of the genae, fuscous. Palpi yellow. Antennae variable; usually the scape and pedicel yellow with their outer and upper surfaces black, black pubescent; flagellum black, brown or yellowish at the base. Dorsum of thorax and scutellum green-gray pollinose, sparsely yellow pubescent, the former with three fuscous stripes; pleurae and venter yellowish-gray pollinose, the former with yellow pile. Dorsum of abdomen yellow; the first tergite with a black quadrate posteriorly emarginate spot beneath the scutellum, second tergite with a median black geminate figure, not attaining the posterior margin; tergites III and IV with a more or less double black geminate figure confined to the anterior half of the tergites; tergites V and VI more or less corresponding to the preceding, except the pattern seems to be composed of two posteriorly emarginate black spots confined to the anterior margins of the tergites; remaining tergite black with a yellow hind margin. Venter of abdomen yellow with a small median black spot on segment I which may connect with another on segment II; segments III to V usually with a trace of black in the center confined to the anterior margins; remaining segments black with yellow hind margins. Halteres brown. Wings as figured; the picture very dilute brown; usually the infuscation of cell R is interrupted by hyaline before the apex. Legs orange-yellow; the joints, apical portion of front tibiae and entire tarsi, apices of middle and hind tarsi, fuscous. Male: Quite similar to the female, easily associated, exhibiting the usual sex differences and more melanism. The black figures of the abdominal dorsum are more extensive, the median geminate spot on tergite II thicker, in one specimen a black spot is present on each side. Cell 2d M of the wing exhibits about the same degree of infuscation as R. Legs like the female, but with more fuscous as follows: Dominant on the front coxae, large basal portions of front and hind femora, and extreme base of middle femora.

Comparative Notes. Separated from *C. furcata* Walker by the dilute wing picture, different abdominal pattern, absence of a black spot on each side of the frontoclypeus, and greater predominance of yellow on the abdomen and legs. The black frontal callus and abdominal picture should at once distinguish this species from *C. coloradensis* Bigot.

Remarks. Described from reared specimens variously determined as *C. coloradensis* Bigot and *C. furcata* Walker.

Type Data. Holotype: Female, Topaz, California, June 7, 1919, Bishopp, No. 9916. Allotype: Male, Topaz, California, July 16, 1917, Bishopp, No. 6164, Br. 2. Paratypes: Five males and nine females same locality, reared by Bishopp; May 16 to July 10, 1917; three females, Slinkard Valley, California, June 17, 1917; J. L. Webb. Holotype, allotype and eleven paratypes in the United States National Museum; catalog No. 50605. Six paratypes in the Francis Huntington Snow Entomological Collection of the University of Kansas.

Chrysops bistellata Daecke (1905)

(Plate XXXIII, fig. 63)

1905. *C. bistellatus* Daecke, Ent. News, XVI, 249, figs.
1907. *C. bistellatus* Daecke, Ent. News, XVIII, 141, fig.
1907. *C. bistellatus* Hine, Bull. 93, La. Exp. Sta., 26, fig.
1926. *C. bistellatus* Kröber, Stett. Ent. Ztg., LXXXVII, 238, figs.

Color. Yellow and brown; dorsum of thorax greenish gray with three brown stripes, scutellum yellowish, abdominal dorsum yellow with two broad, brown stripes converging anteriorly; hyaline triangle of wings represented by a small spot in cell R_3.

Size. Length, 8 mm. to 9.5 mm.

Structural and Color Characters. Female: Vertex, frons and genae yellow pollinose; frontoclypeus and lower portion of genae denuded, yellow; frontal callus dark brown to black. Antennae slender, yellow; apical portion of flagellum black. Palpi yellow. Dorsum of thorax, pleurae and venter greenish gray to yellow-gray pollinose with the usual distinct broad, brown stripes; scutellum yellow or brown-yellow. Dorsum of abdomen yellow with two broad, brown stripes converging toward the base, but not attaining the first segment. Apical segments caudad from V mostly brown. Venter of abdomen predominantly yellow at the base and brown at the apex. Halteres dark brown. Wings as figured. Legs yellow and brown; front coxae, femora and proximal portion of tibiae, middle femora tibiae and proximal parts of middle and hind tarsi, yellow. Male: Unknown.

Comparative Notes. This species has little or no affinities with other North American forms; it is most distinct and separable beyond question from any other species described to date.

Remarks. The male is not yet reported. Daecke's description goes into more detail and points out the extent of variability in the abdominal pattern. Both Daecke (1905) and Kröber (1926) have figured the dorsum of the abdomen and the wing. Kröber's figure of the abdominal pattern overaccentuates the apical extent of yellow.

Type Data. Described from sixteen females designated as cotypes; all from Browns Mills Junction, New Jersey, June 26, 1905. I have studied those in the United States National Museum and one cotype in the Snow Entomological Collection of the University of Kansas. (Two of these labeled June 27, 1904).

Distributional Data:

UNITED STATES: New Jersey, Browns Mills Junction, June 25, 1905, June 24, 1906, July 1, 1906, June 25, 1911, July 7, 1907. North Carolina, Lake Ellis, May 26, 1908.

In addition, reported by others from:

UNITED STATES: Louisiana.

Chrysops brimleyi Hine (1904)

(Plate XXXI, fig. 25)

1904. *C. brimleyi* Hine, Can. Ent., XXXVI, 55.
1907. *C. brimleyi* Daecke, Ent. News, XVIII, fig.
1909. *C. brimleyi* Greene, Ent. News, XX, 302, fig.; ♂ des.
1918. *C. brimleyi* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 196.
1926. *C. brimleyi* Kröber, Stett Ent. Ztg., LXXXVII, 269.

Color. Fuscous with gray pruinosity and pubescence.

Size. Length, 6 mm. to 7 mm.

Structural and Color Characters. Female: Vertex, frons, and genae yellowish pollinose. Frontal callus, lateral projection of the yellow frontoclypeus, and lower margin of the genae, brown. Antennae slender, the flagellum exceeding the pedicel in thickness; scape and pedicel yellow, flagellum mostly black. Palpi brown. Dorsum of thorax and scutellum fuscous, light-gray pubescent. The fuscous ground color of the pleurae and venter gray pruinose, the former with whitish pile. Dorsum of abdomen fuscous with gray pubescence and narrow grayish hind margins on all the segments (in some specimens this last character is observed with difficulty); on the second and third segments the gray hind margins expand into small middorsal triangles, more or less distinct. Venter of abdomen shining fuscous. Halteres fuscous. Wings as figured. Legs brown; more dilute on the proximal portions of the anterior tibiae, median and posterior tarsi, and most of the median tibiae. Male: According to Green (1909), "Like the female, except basal half of the antennae clothed with long, black hair. Frontal triangle gray pollinose, with the apex shining black. Thorax black, clothed with black hairs, no stripes visible. The abdomen black, with the posterior margins of all the segments, except the first, gray pollinose. The wings differ from the female in having the basal end of the black crossband reaching slightly beyond the middle of the anal cell. The first basal cell has two hyaline spots near the apex, and the second basal cell one. First submarginal cell with a hyaline spot at the base. The discal cell has a hyaline spot at the base, the fifth posterior cell has a semihyaline spot at the base and one at the apex. The apical spot reaches downward over the upper end of the marginal cell, covering about half of the first submarginal and nearly all of the second submarginal cell. A small, black spot at the apex of the posterior branch of the third vein. Length, about 8 mm."

Comparative Notes. Hine (1904) separates this species from *C. niger* Macq., from which it is distinguished by the presence of an apical spot on the wings, somewhat smaller size and different color. In this last character *C. brimleyi* resembles *C. fuliginosa* Wied., but is immediately separated by the wing picture, color of antennae, etc.

Remarks. I have not been able successfully to identify the male. The description given for the sex by Greene (1909) is not satisfactory. Obviously it is a description of a specimen and not a species. He states that it is based upon one specimen from Glassboro, New Jersey, May 19, 1907, and that the females were very common. The description sounds suspiciously like that of *C. fuliginosa* Wied., which species should also be found in that locality. The presence of an infuscated spot at the bifurcation of vein R_{4+5} and the general extent of the infuscation of the wing is certainly applicable to the male of *C. fuliginosa.* The length, 8 mm., seems large for *C. brimleyi,* especially a male.

Type Data. I have seen one metatype at the United States National Museum. Described from a number of specimens from Raleigh, N. C. April and May, 1902.

Distributional Data:

UNITED STATES: New Jersey 7, May 27, July 4; Maryland 1, May 25; Virginia 1, May 7, 10; North Carolina 1, April 28, June 15; Alabama 1, May 1.

In addition, reported by others from:

UNITED STATES: New York.

Chrysops brunnea Hine (1903)

(Plate XXIX, fig. 6; Plate XXXIV, fig. 75; Plate XXXV, fig. 81)

1903. *C. brunneus* Hine, Ohio State Acad. Sci. Spec. Pap. No. 5, p. 34.
1906. *C. brunneus* Daecke, Ent. News, VII, 41.
1907. *C. brunneus* Daecke, Ent. News, XVIII, 146.
1907. *C. brunneus* Hine, Bull. 93, La. Exp. Sta., 26, figs.
1918. *C. brunneus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1926. *C. brunneus* Kröber, Stett. Ent. Ztg., LXXXVII, 258.

Color. Light brown.

Size. Length, 8 mm. to 10 mm.

Structural and Color Characters. Female: Frontal callus, frontoclypeus, genae, antennae, and palpi yellow; the usual areas with yellow pollen; apex of flagellum black. Scape and pedicel of antenna swollen, the former slightly more than the latter. Dorsum of thorax, pleurae and venter yellowish-gray to greenish gray pollinose with distinct brown stripes; scutellum yellow-brown to dark brown. Dorsum of abdomen yellow-brown to brown with more or less faint yellow-white middorsal triangles on segments II to V. Most specimens exhibit narrow, pale, hind margins to all segments except the first and second. Sometimes the middorsal triangles have, on each side near their apices, a small oblique fuscous spot. Venter of abdomen mostly yellow at the base and brown at the apex, occasionally the brown being prolonged toward the base to form an obscure broken midventral stripe on each side of which may appear a lateral streak. Halteres light brown. Wings as figured, the infuscation light brown. Legs yellow; the distal portion of the anterior tibiae and entire tarsi, and the four distal segments of the median and posterior tarsi, brown. Male: Like the female, except for sex characters. One specimen at hand shows considerable dark brown occupying the entire disc of the last five or six abdominal segments, the whitish middorsal triangles being obsolete.

Comparative Notes. Allied to *C. flavida* Wied.; however, that species is more yellow; the abdominal pattern is more conspicuous, the black markings being more prevalent; the wing picture is usually a darker brown, the apical spot of less extent; the scape and pedicel of the antenna much less swollen, in some instances would not be regarded as swollen at all. Hine (1903) states that the antennae of *C. brunnea* are noticeably longer than those of *C. flavida.* Daecke (1906) in his studies of the eye pattern of wing specimens has indicated that the occipital border in *C. brunnea* attains the hind margin of the eye, whereas in *C. flavida* it does not.

Type Data. I have studied Hine's types at the Ohio State

Museum. Described from many specimens taken at Sandusky, Ohio, from June to August, 1902.

Remarks. *C. guiterasi* Brun. May be a synonym of *C. brunnea.* I have not seen the type of *C. guiterasi,* but have seen one specimen (♀) from Cuba thus determined, and it apparently is the same as Hine's species.

Distributional Data:

CANADA: Ontario 1, Aug. 14, Aug. 17.

UNITED STATES: New York 3, June 29, July 26; New Jersey 1, Aug. 9; Maryland 1, July 2; Ohio 5, June 15, Aug. 8; Georgia 1; Florida 1, Aug. 10; Indiana 1, June 29; Louisiana 6, April 27, Sept. 5; Kansas 1, July 22; Texas 4, July 30, Sept. 20; Arizona 1.

In addition, reported by others from:

UNITED STATES: Virginia.

Chrysops callida Osten Sacken (1875)

(Plate XXXI, fig. 33)

1875. *C. callidus* Osten Sacken, Prodrome, I, 379.
1887. *C. callidus* Williston, Trans. Kans. Acad. Sci., X, 132.
1895. *C. callidus* Townsend, Trans. Am. Ent. Soc., XXII, 56.
1903. *C. callidus* Hine, Ohio State Acad. Sci. Spec. Pap. No. 5, p. 35.
1906. *C. callidus* Daecke, Ent. News, XVII, 42.
1907. *C. callidus* Daecke, Ent. News, XVIII, 145, fig.
1907. *C. callidus* Hine, Bull. 93, La. Exp. Sta., p. 28, figs.
1917. *C. callidus* Marchand, Jl. N. Y. Ent. Soc., XXV, 150; biol.
1918. *C. callidus* McAtee and Walton, Proc. Ent. So. Wash., XX, 196.
1920. *C. callidus* Marchand, Mon. Rock. Inst. No. 13, p. 46, biol.
1924. *C. callidus* Wehr, Neb. Univ. Studies, XXII, 113.
1926. *C. callidus* Kröber, Stett. Ent. Ztg., LXXXVII, 284.
1930. *C. callidus* Schwardt and Hall, Bull. 256, Ark Exp. Sta., p. 14, fig.
1930. *C. callidus* Stone, Ann. Ent. Soc. Am., XXIII, 274, biol.
1931. *C. callidus* Schwardt, Jl. Kans. Ent. Soc., IV, 5, biol.
1931. *C. callidus* Philip, Minn. Tech. Bull. LXXX, 83.

The following also refers to this species:

1926. *C. moerens confusus* Kröber, Stett. Ent. Ztg., LXXXVII, 284, fig.

Color. Black, with middorsal yellow triangles on the abdomen and large pale yellow spots on the sides near the base.

Size. Length, 7 mm. to 9 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae, yellow pollinose. Frontal callus black. Basal segments of antennae, frontoclypeus, lower area of genae, and palpi orange-yellow; flagellum of antenna mostly black, except at extreme base. Ocellar area more or less denuded, dark brown. Dorsum of thorax and scutellum green-gray pollinose, the former with the usual three brown stripes; pleurae and venter with more yellowish pruinosity, with the usual brown stripes, the former with yellowish-white pile.

The yellow of the abdominal dorsum with a large quadrate black spot, under the scutellum, which practically attains a broad geminate black figure, on the second segment, which may or may not continue along the posterior margin, and sometimes expands into black lateral spots on the yellow of that segment; remaining segments black with yellow posterior margins which expand into middorsal triangles on III, IV, and V, which sometimes have on each side a yellow oblique spot. Venter of abdomen usually yellow at the base, the black of the apical segments extending toward the base as a broad, broken median stripe with lateral streaks on each side. Wings as figured, sometimes the apex of cell M_3 is not infuscated. Legs yellow and black, the former color distributed as follows: anterior coxae and base of tibiae, median tibiae and metatarsi, proximal half of posterior tibiae and metatarsi. In a few specimens which I am sure are this species, the front coxae are black. Male: Similar to the female, except for sex characters; a more dense pubescence and pilosity; both cells R and 2d M infuscated except small hyaline areas near their apices; a greater portion of the legs black, *i. e.,* the front coxae and most of the front and hind tibiae.

Comparative Notes. See under description of *C. aestuans* Van der Wulp. The yellow sides of the second segment of the abdominal dorsum often show evidence of black triangles encroaching from the posterior margin; this condition of course adds to the difficulties of separating these two species. Kröber (1926) separates his *C. moerens confusa* from *C. callida* principally on the extent of infuscation in cell M_3, stating that the former shows this infuscation but half way, and the latter, completely; however, from large series of *C. callida* I am able to pick out specimens exhibiting both characters. The abdominal pattern is far too variable to be of much taxonomic value. In making measurements concerning the posterior convergence of the vertex in the females it was apparent that in general *C. callida* exhibits a greater convergence than *C. aestuans,* or to express it otherwise, the distance between the eyes across the ocellar area is greater in the latter than in the former.

Quoting from my notes taken on the types of *C. callida* O. S.: "As described. Abdomen quite variable, as indicated. Venter yellow basally, but not always entirely, for a brown spot may appear on I and II, as in one specimen. Wing pattern not wholly constant. No actual black triangles encroach on II of the dorsum, but a variation occurs which might permit this."

Remarks. It is self-evident that to undertake describing a new variety from one specimen of the group of that most variable and difficult *aestuans-callida* complex, is a dangerous proceeding. But this is exactly what Kröber (1926) has done.

Dr. G. S. Walley of the Entomological Branch, Ottawa, Canada, very kindly compared a specimen of *C. callida* O. S. data: (LaCrescent, Minn., Marsh Flats, June 16, 1925, C. B. Philip; det. Philip) with Kröber's type of *C. moerens confusus* and comments as follows: "General dorsal abdominal pattern extremely similar to your specimen, and the second segment identical. Ventral aspect of abdomen: a gradually broadening mid-ventral fuscous stripe commences at base of abdomen and extends posteriorly, occupying the entire width of sternites 5, 6 and 7; midway between this and lateral margins on sternites 3 and 4 a narrow fuscous stripe which on 5 unites with the median one. Legs: Hind femora are uniformly brownish except for narrow black apices, not entirely blackish as in your specimen."

Because of the locality (British Columbia) I am puzzled as to whether or not *C. moerens confusa* Kröber is an aberrant *C. aestuans* Van der Wulp or *C. callida* O. S.; however, from point of separateness, comparison, and description it is more likely the latter species. To further verify my opinion, I have other typical specimens of *C. callida*, same data as specimen compared. I am much more at a loss to understand why Kröber has related his new variety to *C. coloradensis* Bigot, for there are scarcely any similarities.

Type Data. I have studied the types at the Museum of Comparative Zoölogy, and also the specimens of *C. aestuans* Van der Wulp which Osten Sacken used for comparison. Described from eleven females of which I was able to locate six. Osten Sacken (1875) gives as the habitat: New Jersey, Delaware, Connecticut, Detroit, Michigan, and Illinois.

Distributional Data:

CANADA: Ontario 1.

UNITED STATES: Maine 1, July 9; Massachusetts 3, July 1-10; Connecticut 2, June 13-30; New York 6, June 20 - July 25; New Jersey 5, June 20 - Aug. 28; Pennsylvania 3, June 19 - July 5; Delaware 3, June 7-10; Maryland 6, June 4 - July 5; Virginia 8, May 23 - June 18; District of Columbia 1, May 22 - June 14; Michigan 3; Ohio 20, May 24 - July 29; Indiana 1, June 6; Illinois 3, June 14 - July 5; Mississippi 1, July 17; Minnesota 4, June 16 - July 27; Nebraska 1, July 10; Kansas 8, June 12 - Aug. 1; Arkansas 1, April 12-14 (reared); Oklahoma 2, May 23-24; Texas 2, April 28 - June; Colorado 1, June 28.

In addition, reported by others from:

CANADA: Manitoba, British Columbia.

UNITED STATES: Louisiana, Florida, Wisconsin, Iowa, Washington.

Chrysops carbonaria Walker (1848)

(Plate XXX, fig. 20)

1848. *C. carbonarius* Walker, List, I, 203.
1848. *C. carbonarius* Walker, var. γ, l. c.
1901. *C. carbonarius* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 303.
1904. *C. carbonarius* Hine, Ohio Nat., V, 220.
1907. *C. carbonarius* Daecke, Ent. News, XVIII, 140.
1918. *C. carbonarius* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1924. *C. carbonarius* Wehr, Neb. Univ. Studies, XXII, 111.
1926. *C. carbonarius* Kröber, Stett. Ent. Ztg., LXXXVII, 245.
1930. *C. carbonarius* Stone, Ann. Ent. Soc. Am., XXIII, 275, biol.
1931. *C. carbonarius* Philip, Minn. Tech. Bull., LXXX, 84.

The following also refer to this species:

1848. *C. niger* Walker (nec Macq.), List, I, 202.
1850. *C. provocans* Walker, Dipt. Saund., pt. 1. p. 73.
?1850. *C. ater* Macquart, Dipt. Exot., Suppl., IV, 40.
1875. *C. fugax* Osten Sacken, Prodrome, I, 375.
1887. *C. fugax* Williston, Trans. Kans. Acad. Sci., X, 132.
1906. *C. fugax* Daecke, Ent. News, XVII, 41.

Color. Black.

Size. Length, 7 mm. to 9 mm.

Structural and Color Characters. Female: Vertex yellow-gray pollinose; frons, a streak on the frontoclypeus, sides of genae yellow pollinose. Frontal callus, frontoclypeus, genae and palpi fuscous to shinging black; occasionally the palpi display some red-brown; the genae grayish to yellowish pilose. Antennae variable, usually the scape, pedicel and base of flagellum yellowish or reddish; apex of flagellum black. Dorsum of thorax and scutellum black with some green-gray pruinosity and whitish pubescence, the former with obscure gray stripes, pleurae and venter black with considerable green gray pruinosity, the former with gray-yellow pile. Abdomen black with sparse intermixed black and pale pubescence, sometimes on the sides near the base dark-gray pruinose; obscure gray mid-dorsal triangles sometimes present. Halteres black. Wings as figured, but there is a variable extent of infuscation and the presence of a hyaline spot at the base of cell M_3 is not always clearly defined. Legs black; the extreme base of the front and middle tibiae, the middle and hind metatarsi, yellow or reddish. Male: Like the female, except for a greater extent of infuscation in cells R and 2d M of the wings. The hyaline spot at the base of cell Cu_1 usually present. Cell 1st A and anal angle infuscated.

Comparative Notes. To be separated from *C. mitis* O. S. by the presence of a hyaline spot at the base of cell Cu_1. Studied by series *C. carbonaria* is some smaller than *C. mitis,* and it appears that the latter is more apt to exhibit middorsal triangles. Easily separated from *C. nigra* Macq. by the extent of infuscation in cells R and 2d M of the wings.

Remarks. Philip (1931) has given an excellent discussion concerning the variability and separateness of *C. carbonaria* and *C. mitis.* He has shown the difficulties involved in separating the adults, but in the final analysis, resorting to larval characters, verified the distinctness of these two species.

Type Data. The above description is based upon specimens compared with Walker's types by Major Austen at the British Museum. I have also studied the types (eight females) of *C. fugax* O. S. at the Museum of Comparative Zoölogy, Cambridge, Massachusetts. The synonymy of these two species is of too long standing to need further discussion. The type locality of Walker's species is Nova Scotia; Osten Sacken's, Canada, Maine, New Hampshire, Montana, Idaho, and the Yukon River.

Distributional Data:

CANADA: Newfoundland 1, Aug. 8; Quebec 4, May 20, July 24; Ontario 1, June 13; Manitoba 1, June 27; Northwest Territory 1, July 20, 28.

UNITED STATES: Maine 4, June 10 - July 20; Massachusetts 3, June 6 - July 15; New Hampshire 6, June 4 - July 7; New York 4, May - June 28; New Jersey 8, May 24 - July 2; Pennsylvania 2, June 3-21; Maryland 3, May 28 - June 25; Virginia 6, May 26 - July; North Carolina 1, May 15; Michigan 2, July 4 - Aug. 15; Ohio 1, June 4-14; Wisconsin 2, June 4; South Dakota 1; Wyoming 3, July 2-18; Colorado 4, June 20 - July 8; Montana 3, July 10-14; Idaho 1, July 6; Utah 1, July 4; California 1.

In addition, reported by others from:

CANADA: Nova Scotia.

UNITED STATES: Connecticut, Nebraska, Alaska.

Chrysops celer Osten Sacken (1875)

(Plate XXX, fig. 19)

1875. *C. celer* Osten Sacken, Prodrome, I, 376.
1903. *C. celer* Hine, Ohio State Acad. Sci. Spec. Pap. No. 5, p. 36.
1906. *C. celer* Daecke, Ent. News, XVII, 41.
1907. *C. celer* Daecke, Ent. News, XVIII, 39.
1918. *C. celer* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1920. *C. celer* Marchand, Mon. Rock. Inst. No. 13, p. 47.
1926. *C. celer* Kröber, Stett. Ent. Ztg., LXXXVII, 244.
1930. *C. celer* Stone, Ann. Ent. Soc. Am., XXIII, 279, biol.
1931. *C. celer* Schwardt, Jl. Kans. Ent. Soc., IV, 7, biol.
1931. *C. celer* Philip, Minn. Tech. Bull., LXXX, 84.

Color. Black, the female with dense orange pile on the pleurae.

Size. Length, 8 mm. to 11 mm.

Structural and Color Characters. Female: Vertex, frons, a broad longitudinal stripe on the frontoclypeus, sides of genae, yellow or gray-yellow pollinose; frontal callus, ocellar area, frontoclypeus and oral regions of genae, black. Antennae reddish-yellow except the black apex of the flagellum. Palpi reddish-brown to fuscous. Thoracic dorsum and scutellum black with white pubescence, the former faintly striped with gray; pleurae and venter black with grayish pruinosity, the former with dense orange pile. Dorsum of abdomen black with white pubescence and more or less indistinct gray middorsal triangles on segments II and III. Venter of abdomen black with white pubescence. Ocelli brown. Wings as figured. Legs black; middle and hind metatarsi yellow; the front coxae, middle and hind femora with white hairs. Male: Differs from the female as follows: The antennae are mostly black; pleurae black pilose; cell 1st A of the wings infuscated, and a greater extent of infuscation in cells R and 2d M.

Comparative Notes. Distinguished from *C. amazon* Daecke by the absence of an apical spot on the wing. The females are readily separated from other species of the group lacking an apical spot by the heavy orange pile of the pleurae. Hine (1903) states, "The male is distinguished from that of *niger* by the hyaline spots at the apex of the basal cells, occupying the whole width of these cells; and from that of *fugax* (*C. carbonaria* Walker) by the crossband practically filling out the fourth posterior cell." From *C. excitans* Walker the male is separated by the wholly black pubescence of the abdomen and entirely black antennae.

Remarks. Ricardo (1901) doubtfully makes *C. celer* O. S. and *C. cincticornis* Walker synonyms. In this she has been followed by others, all with a doubt. Major Austen of the British Museum has compared one of my specimens of *C. celer* with Walker's type of *C. cincticornis* and asserts that they are not the same.

Type Data. Described from eight females of which I have seen four. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts. Habitat given as Middle States and Massachusetts.

Distributional Data:

CANADA: Quebec 4, July 1-27; Ontario 3, June 7 - July 19.

UNITED STATES: Maine 2, July 3-17; Massachusetts 3, June 17 - July 15; Connecticut 1, July 21; New York 3, May 27 - July 27; New Jersey 4, May 20 - June 21; Pennsylvania 4, June 8 - July 8; Maryland 4, May 25 - June 18; Virginia 7, May 24 - June 19; North Carolina 2, May 4-7; Michigan 1, June 29; Ohio 6, May 20 - July 1; Indiana 1, May 27; Illinois 1, June 12-13; Oklahoma 1, May 29.

In addition, reported by others from:

CANADA: Newfoundland, Nova Scotia, Saskatchewan.

UNITED STATES: District of Columbia, Wisconsin, Minnesota, Arkansas.

Chrysops clavicornis, new species

(Plate XXIX, fig. 8; Plate XXXIV, fig. 64; Plate XXXV, fig. 85; Plate XXXVII, figs. 105, 110)

Color. Yellow, with black abdominal pattern; appendages yellow.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Vertex, frontal callus, frontoclypeus, genae, and palpi yellow, the usual regions with yellow pollen. Ocellar area, a margin around the callus, and a spot on the genae, brown. Vertex and genae with rather dense pile. Scape and pedicel of antenna yellow with black hairs, flagellum mostly black; the bottle-shaped scape is distinctly swollen. Dorsum of thorax and scutellum yellow-gray pollinose, yellowish pilose, the former with faint brown stripes. Pleurae and sternal region yellow-gray pollinose with fuscous stripes, the former with dense yellow-white pile. Dorsum of abdomen yellow with a quadrate black spot under the scutellum which nearly unites with the geminate spot of the second segment. Segments III, IV and V usually with a double geminate black spot; the remaining segments black; all with yellow posterior margins. Sometimes a small black lateral spot appears on segment II, in one specimen also on segment I. Venter of abdomen yellow with a complete fuscous mid-stripe and two lateral stripes. Wings as figured, the hyaline triangle sometimes more broadly open at the base; in one specimen the apical spot definitely ending in cell R_5. Legs yellow; all joints, apical portion of front tibiae and entire tarsi, apical tarsal segments of middle and hind legs, fuscous. Posterior tibiae with rather long, black hairs. Male: Predominantly black. Head and its appendages as described for the female except the sex characters. Thorax and scutellum exhibit more brown ground color, more densely pilose. First abdominal segment almost entirely black except the yellow lateroposterior margin; second with a large trapezoidal black spot encroached upon from the posterior margin by a yellow triangle, the yellow on each side with a black spot; the remaining segments as in the female, except that black is more dominant. Venter of abdomen yellow with three black stripes. Wing picture like the female, except that the infuscation of cell 2d M is equal to that of cell R, and the base of cell 1st A is infuscated. Legs as described for the female, in addition, the apical portion of the front femora and of the hind tibiae are fuscous.

Comparative Notes. The abdominal pattern resembles that of *C. coquilletti* Hine, from which *C. clavicornis* may be separated by the much greater extent of the apical spot and the more narrow hyaline triangle. The characteristic bottle-shaped scape of the antenna generally does not appear to be so swollen as in any of the related species.

Type Data. Holotype, female; San Diego Co., California; July 7, 1929, R. H. Beamer. Allotype, male; same data. Paratypes: four females, same data; one female, same locality and date, Paul W. Oman; one female, Los Angeles Co., California; one female, Riverside, California, Mission Inn, September 3, 1930, D. Martin; four females, Ontario, California, July 10-13, 1917. In the Francis Huntington Snow Entomological Collection of the University of Kansas. The Ontario, California, paratypes in the Ohio State Museum.

Chrysops coloradensis Bigot (1892)

(Plate XXXI, fig. 34)

1892. *C. coloradensis* Bigot, Mem. Soc. Zoöl. France, V, 605.
1901. *C. coloradensis* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 307.
1904. *C. coloradensis* Hine, Ohio Nat., V, 220.
1926. *C. coloradensis* Kröber, Stett. Ent. Ztg., LXXXVII, 293.

Color. Tawny with black abdominal pattern, and considerable yellowish pubescence throughout.

Size. Length, 8 mm. to 10 mm.

Structural and Color Characters. Female: Frontal callus yellow, margined above with brown; frontoclypeus, genae and palpi orange-yellow; the pits on each side of the frontoclypeus and a small spot near the oral margin of the genae, brown; the usual areas yellow pollinose. A brown line usually connects the more or less denuded ocellar area and the frontal callus. Antennae yellow and black as follows: Scape and pedicel on inner and lower surfaces yellow, on outer and most of upper surfaces black, with black pubescence; flagellum yellowish at base, black at apex. Dorsum of thorax and scutellum green-gray to yellow-gray pollinose, the former with three broad, brown stripes, the latter sometimes appears plumbeus. The pruinosity of the pleurae and venter of the thorax broken by the usual brown stripes. Dorsum of abdomen tawny yellow with a black emarginate quadrate spot beneath the scutellum, not attaining the hind margin of the first segment; second segment with two obliquely angulate black spots on the disc, not attaining either margin; in addition to these spots on the third, fourth and fifth segments is a black lateral spot, often the black figures on these segments may be in the form of two geminate spots; remaining segments black with yellow hind margins. Venter of abdomen yellow, usually with a mid-ventral brown stripe and the usual lateral ones; apical segments brown with yellow hind margins. I have one specimen without a trace of a mid-ventral stripe. Halteres yellow with brown knobs. Wings as figured. Legs yellow; all joints, apical portion of anterior tibiae and entire tarsi, the four distal segments of the median and posterior tarsi, brown. Male: In general this sex resembles the female and is not difficult to associate with it. There is a greater extent of black on the dorsum of the abdomen, segments II and IV each with a double geminate spot. The infuscation of cell 2d M of the wing equals or slightly exceeds that of cell R_1, likewise there is a greater infuscation along veins Cu_1 and Cu_2. Legs as in the female except the front coxae, large basal portion of front and hind femora, and middle femora at the base, fuscous.

Comparative Notes. Hine (1904) has related *C. coloradensis* to *C. proclivis* O. S., but it appears more closely allied to *C. furcata* Walker, from which it may be separated by the yellow frontal callus and generally greater extent of yellow in the facial regions, and the two spots on the second abdominal tergite instead of a single germinate one. In both *C. proclivis* and *C. furcata* the prevailing yellow is more orange whereas in *C. coloradensis* it is more tawny. Kröber (1926) states, ". . . grosze Ahnlichkeit mit *furcatus* (*C. montana*), *lupus* (*C. furcata*) und *moerens* (*C. aestuans*)." Ricardo (1901) redescribes the type and she also relates this species to *C. furcata* Walker.

Remarks. This is the first time that the male of this species has been described. My notes are based on a single specimen in the United States National Museum from Topaz, California.

Type Data. Two females from Colorado. In the British Museum. The other specimens of the series are *C. fulvastra* O. S. See Ricardo (1901).

Distributional Data:

United States: Nevada, Fallon, June 17-18, 1930; Pyramid Lake, July 16, 1911. California, Oreville, May 11, 1921; Orange Co., July 14, 1929; Topaz, July 8-10, Aug. 12, 1919. Santa Cruz Mts., Plumas Co., March.

In addition, reported by others from:

United States: Colorado, Washington, Oregon.

Chrysops coquilletti Hine (1904)

(Plate XXXIV, fig. 65; Plate XXXV, fig. 84; Plate XXXVII, figs. 111, 112)

1904. *C. coquilletti* Hine, Ohio Nat., V, 220.
1926. *C. coquilletti* Kröber, Stett. Ent. Ztg., LXXXVII, 263.

Color. Yellow, with black abdominal pattern; appendages mostly yellow.

Size. Length, 8 mm. to 9 mm.

Structural and Color Characters. Female: Vertex broader than long, yellow pollinose; sides of genae and a midstreak on the frontoclypeus yellow pollinose; region immediately surrounding antennae white pollinose; ocellar area denuded, black; frontal callus yellow margined above with black; frontoclypeus and oral margin of genae yellow, the latter with a small fuscous spot. Palpi yellow. Antennae incrassate, the scape extremely bulbous, practically swollen uniformly throughout; both scape and pedicel yellow with black pubescence; flagellum black except for a little yellow at the base. Dorsum of thorax and scutellum fuscous, pruinose, with yellowish pile, the former with gray-yellow pollinose stripes; pleurae and venter gray-yellow pollinose with the usual brown stripes, the former with yellowish pile. Dorsum of abdomen yellow with a quadrate black spot beneath the scutellum, posteriorly emarginate; second segment with a heavy geminate black mid-spot which attains the anterior margin; segments III, IV and V each with four black spots, the median pair the larger and conforming more nearly to the geminate spot on segment II; remaining segments mostly black with yellow hind margins. Venter of abdomen yellow with a black median stripe and the usual black lateral stripes; apical segments black with yellow hind margins. Halteres yellow. Wings as figured; the apical spot including less than half of cell R_4. Legs yellow, all the joints, apical portion of front tibiae and entire tarsi, the four apical segments of the middle and hind tarsi, black. Male: Like the female, except for sex characters. The dorsal abdominal pattern differs as follows: The black quadrate spot beneath the scutellum is more extensive, scarcely emarginate posteriorly, and practically coalesces with the black geminate figure on the second tergite; on the third tergite the median pair of angular black spots are much smaller; remaining tergites like the female. Venter of abdomen like the female. Wings like the female; the base of cell 1st A is hyaline, the extent of infuscation into cell 2d M is not more than in the female. Legs like the female; in one specimen the apical portion of the hind tibiae is black.

Comparative Notes. This species is generally larger than *C. pachycera* Will. and as a rule both sexes exhibit much more black on the abdomen; in the female the infuscation of cell 2d M in *C. pachycera* is more confined to the base than in *C. coquilletti,* where it often continues tapering toward vein M and ending with the infuscation of cell R; however, in the male, the infuscation of cell 2d M in the former is more extensive than in the latter; frequently the wing picture of *C. pachycera* is fenestrate, but I have never seen this condition in *C. coquilletti*. From *C. clavicornis* n. sp. *C. coquilletti* may be easily separated by the scape of the antennae, which is practically barrel-shaped and extremely swollen; in the former the scape is not so swollen and is typically bottle-shaped; also the extent of the apical spot of the wing in *C. clavicornis* is considerably greater than in *C. coquilletti*. Also see under description of *C. robusta* n. sp.

Remarks. Part of Hine's types are my *C. clavicornis*. See under type data.

Type Data. Two females and one male labeled "cotypes" in the Ohio State Museum. One female, Los Angeles Co., California, April, collection Coquillett, I accept as the true *C. coquilletti* Hine and hereby designate this specimen as the lectotype. One female, Pasadena, California, June 12, 1895, R. W. Doane, is my *C. clavicornis;* the bottle-shaped scape of the antenna, the extent of the apical spot of the wing into cell R_5, and a black lateral spot on the second abdominal tergite easily identify this specimen. One male, Los Angeles Co., California, collection Coquillett, conforms well to my male of *C. clavicornis*.

Distributional Data:

UNITED STATES: California: Dulzura, May 15, 1917; Poway Co., San Diego Co., April 12, 1930; Los Angeles Co., April; Lindsay. Utah: Zion National Park.

Chrysops cuclux Whitney (1879)

(Plate XXX, fig. 14)

1879. *C. cuclux* Whitney, Can. Ent., 35.
1906. *C. cuclux* Daecke, Ent. News, XVII, 404.
1907. *C. cuclux* Daecke, Ent. News, XVIII, 140.
1918. *C. cuclux* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1926. *C. cuclux* Kröber Stett. Ent. Ztg., LXXXVII, 253.
1930. *C. cuclux* Stone, Ann. Ent. Soc. Am., XXIII, 280, biol.
1931. *C. cuclux* Philip, Minn. Tech. Bull., LXXX, 85.

The following also refers to this species:

1901. *C. cuchix* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 300.

Color. Fuscous, abdomen with a gray-yellow spot on each side near the base, crossband of wings not saturate.

Size. Length, 7 mm. to 9 mm.

Structural and Color Characters. Female: Frontal callus, ocellar space, frontoclypeus and oral margins of genae, dark brown; vertex, frons, sides of genae, and a broad, longitudinal stripe on the frontoclypeus, grayish-yellow to creamy yellow pollinose. Antennae rather slender; the scape and pedicel yellowish, flagellum black except for a little yellow at the base. Palpi brown. Thoracic dorsum and scutellum black with whitish pubescence; pleurae and venter with the black ground color hidden by some gray pruinosity, the former with yellow-white pile. Dorsum of abdomen fuscous with whitish pubescence; the sides of the first two segments deeply encroached upon by gray-yellow spots. Venter of abdomen fuscous with whitish pubescence. Halteres fuscous. Wings as figured, the picture dilutely infuscated. Legs brown except the yellowish median and posterior metatarsi. Male: Similar to the female in all respects except for the usual sex characters, and hence easily associated.

Comparative Notes. Whitney (1879) compares this species to *C. sordida* O. S., stating, ". . . but is smaller, lacks the gray posterior margins of the abdominal segments, the crossband is more abbreviated and lighter colored, and the second basal cell is further infuscated." *C. cuclux* is a distinct species and should offer no difficulties in separating it from any of the group lacking the apical spot on the wing.

Remarks. This is the first time the male has been reported.

Type Data. Described from seventeen females, all taken at Milford, New Hampshire, in June. Four of these are still preserved at the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

CANADA: Nova Scotia 1, June 24; Quebec 2, May 24.

UNITED STATES: Maine 3, June 18-28; Massachusetts 3, June 16; New Hampshire 4, May 30 - June; Connecticut 1, June 23-24; New York 4, May 30 - June 29; New Jersey 1; Pennsylvania 2, June 22; Michigan 2, June 10 - July 6; Ohio 4, June 1-8.

In addition, reported by others from:

CANADA: Ontario.

UNITED STATES: Maryland, North Carolina.

Chrysops cursim Whitney (1879)

(Plate XXXII, fig. 44)

1879. *C. cursim* Whitney, Can. Ent., XI, 36.
1887. *C. cursim* Williston, Trans. Kans. Acad. Sci., X, 134 (syn. of *C. pudica* O. S.).
1901. *C. cursim* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 300.
1906. *C. cursim* Daecke, Ent. News, XVII, 41.
1907. *C. cursim* Daecke, Ent. News, XVIII.
1914. *C. cursim* Whitney, Can. Ent., XLVI, 345.

Color. Yellow, with more or less faded black abdominal pattern; crossband of the wings very dilute.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Frontal callus, frontoclypeus, genae, palpi, basal segments of antennae yellow; the usual areas pollinosed, including the ocellar space; flagellum of antennae black apically. Dorsum of thorax and scutellum with gray-yellow pollen, the former with brown stripes; pleurae and venter pruinose with the usual stripes. Dorsum of abdomen yellow with an inverted V-shaped black spot on the second segment which does not attain either margin; the remaining segments with more or less emarginate black bands on their anterior margins; sometimes these figures conform more or less to the spot on segment II. Venter of abdomen yellow, only the extreme apex fuscous. Halteres yellowish. Wings as figured, the dilute crossband inclined to be irregular. Legs yellow; apical portions of front and hind femora and tibiae, entire front tarsi and distal four segments of middle and hind tarsi, brown. Male: Similar to the female except for the usual sex characters and the crossband usually more saturate.

Comparative Notes. This species is related to *C. pudica* O. S. of which Williston (1887) considers it a synonym. Kröber (1926) follows Williston, but undoubtedly lacks any other evidence. I have seen no intergrading forms, so I prefer to consider these as two distinct species. *C. cursim* exhibits more yellow throughout; the crossband is much more dilute and usually more irregular; the frontal callus is always yellow, sometimes margined above with brown. In *C. pudica* the frontal callus is variable, often brown; the dorsum of the thorax and scutellum are more plumbeus; the hind femora are mostly fuscous at the base; a black spot is usually present beneath the scutellum; both the dorsum and venter of the abdomen exhibit a greater extent of black.

Type Data. Described from six females, Milford, N. H., June.

Distributional Data:

UNITED STATES: New Jersey 4, June 16 - July 20; Maryland 2, June 5 - July 19; North Carolina 3, May 23 - June 16; Florida 4, April 12 - June 6.

In addition, reported by others from:

UNITED STATES: New Hampshire, Massachusetts, Connecticut, New York, Pennsylvania.

Chrysops delicatula Osten Sacken (1875)

(Plate XXXI, fig. 31)

1875. *C. delicatulus* Osten Sacken, Prodrome, I, 380.
1906. *C. delicatulus* Daecke, Ent. News, XVII, 42.
1907. *C. delicatulus* Daecke, Ent. News, XVIII, 144.
1926. *C. delicatulus* Kröber, Stett. Ent. Ztg., LXXXVII, 265.

Color. Predominantly black with creamy yellow abdominal triangles.

Size. Length, 6.5 mm. to 8 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae, ocellar area, yellow to creamy yellow pollinose; frontal callus a spot on each side of the frontoclypeus, a spot on the oral area of the genae dark brown to black; frontoclypeus, palpi, scape and pedicel of antenna reddish yollow; flagellum of antenna black except the reddish basal portion. Thoracic dorsum, pleurae and venter gray-yellow pruinose with the usual brown stripes. Scutellum plumbeus. Dorsum of abdomen yellow with a black quadrate spot beneath the scutellum, not quite attaining a black geminate figure on the second segment which may or may not continue along the posterior margin; remaining segments black, the yellow hind margins of III, IV and V expanding into small middorsal triangles. Venter of abdomen yellow, the anterior margins caudad from III, black; black lateral streaks usually present. Halteres fuscous. Wings as pictured. Legs black; the proximal portion of the front tibiae, nearly all of the middle tibiae, the middle and hind metatarsi, reddish yellow. Male: Not identified; probably much like the female except for greater melanism.

Comparative Notes. To be separated from *C. callida* O. S. by its generally smaller size; the crossband of the wings attenuated posteriorly; and the brown spots on the frontoclypeus and genae.

Type Data. Described from two females from North Conway, New Hampshire, middle of August, 1874. I have studied both specimens; they have faded somewhat, but otherwise are in good condition. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: Maine 1, June; New Hampshire 1, Aug.; Connecticut 1; New York 1, June 29; New Jersey 4, June 24 - July 4; Michigan 2, July 3-14.

In addition, reported by others from:

CANADA: Ontario.

Chrysops dimmocki Hine (1905)

(Plate XXXI, fig. 30)

1905. *C. dimmocki* Hine, Ohio Nat., VI, 393.
1906. *C. dimmocki* Daecke, Ent. News, XVII, 41.
1907. *C. dimmocki* Daecke, Ent. News, XVIII, 145.
1918. *C. dimmocki* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1926. *C. dimmocki* Kröber, Stett. Ent. Ztg., LXXXVII, 294.

Color. Black, with yellow abdominal triangles.

Size. Length, 7.5 mm. to 9 mm.

Structural and Color Characters. Female: Vertex, frons and side of genae with gray-yellow pollen; frontoclypeus, genae, palpi and basal segments of antennae, yellow; flagellum of antenna yellow basally and black apically; frontal callus variable, black to yellow. Dorsum of thorax greenish-gray pollinose with three brown stripes; pleurae and venter grayish-yellow pollinose with the usual brown stripes; scutellum concolorous with thoracic dorsum, sometimes yellow at the tip. First abdominal tergite with a quadrate black spot beneath the scutellum, not attaining the posterior margin; second tergite with an inverted V-shaped or geminate black spot attaining the anterior margin and may or may not follow along the posterior margin; remaining segments more or less black, the yellow posterior margins expanding into middorsal triangles. Venter of abdomen yellow, a black spot, successively increasing in size on segments III, IV and V; remaining segments black with yellow hind margins; the usual brown lateral streaks present. Wings as figured. Legs yellow; the joints, apical portion of front tibiae and entire tarsi, large basal portion of hind femora, apex of hind tibiae, apical four tarsal segments of middle and hind legs, fuscous. Male: I have but one specimen which I believe to be the male of this species. Superficially it approximates this sex in *C. sackeni* Hine, but the greater extent of infuscation in cell 2d M and the broader apical spot offer separable characters. It differs from the female as follows: Thoracic dorsum and scutellum darker; the median yellow triangles on the abdominal dorsum practically obsolete, tergites III and IV yellow on the sides; the black quadrate median spots of the venter attain the base; cells R and 2d M of the wing considerably infuscated except for a small hyaline space near their apices, cells Cu_1 and 1st A more extensively infuscated. Legs fuscous, bases of front and hind tibiae, entire middle tibiae, middle and hind metatarsi, yellow.

Comparative Notes. This species is related to *C. pudica* O. S., from which it should be separated by the greater extent of the apical spot into cell R_4. In general there is a greater extent of black on the abdominal dorsum of *C. dimmocki,* and the vertex of the median figure on the second tergite reaches the anterior margin. Based on the original descriptions these two could be separated by the black frontal callus in *C. dimmocki* and the yellow one in *C. pudica,* but unfortunately this character is variable in each species. The characters offered by the apical spot of the wing and the dorsal abdominal pattern have thus far proved most useful, although I have at hand specimens which show intergradation.

Type Data. I have studied the types. Described from one female, Longmeadow, Massachusetts, and eight other specimens from Columbus and Wauseon, Ohio; and Anglesea and Westfield, New Jersey. Five cotypes in the Ohio State Museum.

Distributional Data:

UNITED STATES: Massachusetts 1, July 24; Connecticut 1, June 27 - July 22; New York 3, June 23-31; New Jersey 2, June 11-19; Virginia 1, Aug. 14; North Carolina 1, May 8-27; Georgia 1, May 9 - June 8; Florida 1, March 17; Ohio 2, June 12-14.

In addition, reported by others from:

UNITED STATES: Rhode Island.

Chrysops discalis Williston (1880)

(Plate XXXIV, fig. 72)

1880. *C. discalis* Williston, Trans. Conn. Acad. Sci., VI, 245.

1904. *C. discalis* Hine, Ohio Nat., V, 221, ♂ desc.

1921. *C. discalis* Francis, Public Health Reports, XXXVI, 1731-1792 (Transmission of tularaemia).

1922. *C. discalis* Francis and Mayne, Bull. 130, U. S. Pub. Health Service, Hyg. Lab., p. 8.

1924. *C. discalis* Wehr, Neb. Univ. Studies, XXII, 112.

1926. *C. discalis* Cameron, Bull. Ent. Res., XVII, 18 (larva and pupa).

The following also refers to this species:

1926. *Heterochrysops discalis* Kröber, Stett. Ent. Ztg., LXXXVII, 236.

Color. Female: Gray to yellow-gray with black spots on the abdomen, the wing picture fenestrate. Male: Predominantly black with yellow-gray spots on the abdomen, the wing picture fenestrate.

Size. Lenth, 8 mm. to 10.5 mm.

Structural and Color Characters. Female: Vertex, frons, ocellar area, sides of genae, and a broad stripe the full length of the frontoclypeus creamy yellow pollinose; frontal callus and a small spot on the frontoclypeus just next the pollinose stripe, black; remainder of frontoclypeus, a spot on the oral margin of the genae, and palpi pale yellow. Antennae mostly black, the scape and pedicel often yellowish on their inner and lower surfaces, with black and white pubescence intermixed. Dorsum of thorax and scutellum gray-yellow pollinose, the former with three brown stripes; pleurae and venter gray-yellow pollinose with the usual brown stripes, the former with dense yellow-white pile. Dorsum of abdomen gray yellow with a black spot, broader than long, beneath the scutellum, not attaining the hind margin of the first segment; second segment with two black angular spots on the disc whose bases attain the anterior margin and whose apices are directed toward the posterior margin which they do not reach; on the remaining segments those spots become successively smaller; in some specimens the extreme apical segments are mostly black with yellowish hind margins; in addition to these markings, all segments have a black spot on each side. Venter of abdomen yellow with a black spot on the disc of each segment becoming successively larger toward the apex; the usual lateral streaks appear as dotted lines. Halteres yellow with brown knobs. Wings as figured, the hyaline discal cell and spot at the bifurcation of vein R_{4+5} are quite characteristic. Legs yellow; the joints, apical portion of front tibiae and entire tarsi, the proximal four segments of the middle and hind tarsi, brown. Male: Darker than the female, but readily associated. Head similar to that of female except for sex characters; the antennae wholly black. Dorsum of thorax and scutellum predominantly black, the former with gray pollinose stripes; pleurae and venter black with pollinose stripes, the pile of the former black and white intermixed. Dorsum of abdomen with first segment entirely black except for a small yellow lateral spot; remaining segments black, the gray-yellow posterior margins encroaching to form middorsal triangles, on each side of which is a longer spot almost attaining the anterior margin of the segment; segments VI and VII mostly black with narrow yellow hind margins. Venter of abdomen like the female, except the black occupies more space. Wing picture like the female except a much greater extent of infuscation in all cells. Legs black; the extreme base of the front tibiae, apex of middle femora, middle and hind tibiae except extreme apices, middle and hind metatarsi, yellow.

Comparative Notes. *C. discalis* is distinct from all other North American species. The general color and wing pattern is suggestive of *C. fulvastra* O. S., but the swollen antennae of that species, smaller size, etc., will easily separate it.

Type Data. One female in the Snow Entomological Collection of the University of Kansas.

Distributional Data:

UNITED STATES: North Dakota 1, June 26 - July 19; Nebraska 1, July 10; Wyoming 5, June 23 - Aug. 3; Colorado 1, June 28; Utah 14, May 17 - Aug. 27; Nevada 3, June 10 - July 17; Washington 1, Sept. 4; Oregon 3, July 15-30; California 3, May 8 - Aug. 13.

In addition, reported by others from:

CANADA: Manitoba, Saskatchewan.

UNITED STATES: Montana.

Chrysops dissimilis, new species

(Plate XXXIV, fig. 73; Plate XXXV, fig. 79)

Color. Orange-yellow with black abdominal pattern.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Vertex slightly longer than broad, gray-yellow pollinose; frons, a midstreak on the frontoclypeus and sides of genae gray-yellow pollinose. Frontal callus brown-yellow, broadly bordered on the sides and above with fuscous. Frontoclypeus and oral margins of genae, except for a small fuscous spot on each side of the latter, orange-yellow. Palpi orange-yellow, sometimes with some fuscous intermixed. Antennae orange-yellow except for the black apical portion of the flagellum, sometimes the outer sides of the pedicel fuscous; both scape and pedicel with short, black hairs, the former more or less bottle-shaped and distinctly more swollen than the latter. Dorsum of thorax and scutellum yellow-gray or mouldy-gray pollinose, white pubescent, the former with obscure stripes; pleurae and venter gray-yellow pollinose, with yellow-white pile. Dorsum of abdomen orange-yellow, the black quadrate spot beneath the scutellum barely attaining the posterior margin of the first segment; the median black figure of the second segment is quite variable, sometimes appearing as two vittate spots parallel or posteriorly divergent, sometimes as a geminate or inverted V-shaped spot which rarely attains the anterior margin of the segment and never the posterior; segments III, IV and V each with a pair of median black vittate spots which attain the anterior, but not the posterior margins; sometimes small, black lateral spots are present, the pattern of segment V very obscure; remaining segments dominantly fuscous with yellow hind margins. Venter of abdomen orange-yellow, as a rule, with a distinct fuscous mid-stripe broadening toward the apex; the usual fuscous lateral stripes present. Halteres yellow. Wings as pictured. Legs orange-yellow; the joints, apical portion of front tibiae and entire tarsi, apical four segments of middle and hind tarsi, fuscous. Male: Except for sex characters, much like the female and easily associated. The black quadrate spot beneath the scutellum is larger and practically attains the hind margins of the first abdominal segment; the median figure on the second segment is more nearly a black quadrate spot posteriorly emarginate, than a geminate spot, as in the female. Wings and legs like the female. This sex exhibits less variation in the dorsal abdominal pattern. The lateral spots on segments III to V are lacking.

Comparative Notes. This species is quite distinct from all other North American Chrysops. The relatively narrow apical spot of the wing associated with an incrassate scape is unique. The abdominal pattern of the female is very similar to that of *C. pachycera* Will.

Type Data. Holotype, female; Lost River, Chaves Co., N. Mex., July 10, 1933, J. M. Brennan. Allotype, male; same data. Paratypes, seven males and twenty females; same data. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

Chrysops divisa Walker (1848)

(Plate XXX, fig. 22)

1848. *C. divisus* Walker, List, I, 204.
1901. *C. divisus* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 303 (syn.).

The following also refers to this species:

1875. *C. atropos* Osten Sacken, Prodrome, I, 372.
1926. *C. atropos* Kröber, Stett. Ent. Ztg., LXXXVII, 240.

Color. Black, wings infuscated completely to distal margin of crossband.

Size. Length, 8 mm. to 10 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae yellow pollinose; ocellar area, frontal callus, frontoclypeus, genae, palpi, and antennae fuscous to black. Thorax and abdomen black with sparse whitish pubescence; pleurae with black pile. Halteres black. Wings as figured, cells Cu_1, 1st A, and the anal angle more dilutely infuscated. Legs black; middle and hind metatarsi yellowish. Male: This sex has never been reported.

Comparative Notes. Easily distinguished from any other species lacking the apical spot of the wing by the wing picture.

Remarks. Ricardo (1901) has established the synonymy of *C. divisa* Walker and *C. atropos* O. S., but Kröber (1926) recognizes the synonymy with a doubt.

Type Data. The above description is based on a specimen compared with Walker's type in the British Museum by Major Austen. I have also studied the specimens on which Osten Sacken based his description of *C. atropos.* Nine females remain in the Museum of Comparative Zoölogy, Cambridge, Massachusetts, among them the type of the description.

Distributional Data:

UNITED STATES: New Jersey: 1 specimen (in the U. S. N. M.) collected by Palm, no other data on label. Florida: Plant City, April 26, 1926; Alachua

Co., March 31, 1908, May 18, 1922; Tampa, July 26; Fla., May 5; Orange Co., April 14, 1930; Polk Co., March 3, 1930; Lakeland; Okeechobe Lake; Eagle Lake; Crescent City.

Chrysops dorsovittata Hine (1907)

(Plate XXXIII, fig. 57)

1907. *C. dorsovittatus* Hine, Ohio Nat., VIII, 229.
1926. *C. dorsovittatus* Kröber, Stett. Ent. Ztg., LXXXVII, 325.

Color. Black and yellow, the yellow of the abdominal dorsum with a broad, black, longitudinal stripe.

Size. Length, 6.5 mm. to 7 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae, a longitudinal stripe on the frontoclypeus, yellow pollinose; ocellar space, frontal callus, frontoclypeus and genae, black. Scape of antenna yellow; pedicel and base of flagellum red-brown; apex of flagellum black. Palpi dark brown. Dorsum of thorax and scutellum fuscous, the former with yellow-gray pollinose stripes; pleurae and venter yellow pollinose with the usual brown stripes. Dorsum of abdomen yellow, the apical three or four segments fuscous, which color extends to the base as a broad median stripe; and on each side as a narrow lateral stripe to the anterior margin of the third segment. Venter of abdomen mostly fuscous, only the first two segments and the sides of the third, yellow, Halteres brown. Wings as figured. Legs black; the front coxae, base of front and middle tibiae, middle and hind metatarsi yellow. Male: Like the female; cell 2d M at the base and the margins along vein Cu infuscated.

Comparative Notes. A distinct species. Readily recognized by the middorsal abdominal stripe and its small size.

Type Data. Described from one female from Georgia and a male from Florida. I have studied both in the Hine collection at the Ohio State Museum.

Distributional Data:

UNITED STATES: Maryland: Glenburnie, June 22, 1922. North Carolina: Southern Pines, May, 1909. Georgia; Florida.

Chrysops excitans Walker (1850)

(Plate XXX, fig. 21)

1850. *C. excitans* Walker, Dipt. Saund., I, 72.
1875. *C. excitans* Osten Sacken, Prodrome, I, 373.
1887. *C. excitans* Williston, Trans. Kans. Acad. Sci., X, 132.
1902. *C. excitans* Howard, Ins. Book, pl. XVI, f. 16.
1904. *C. excitans* Hine, Ohio Nat., V, 222.
1907. *C. excitans* Daecke, Ent. News, XVIII, 139.

1926. *C. excitans* Cameron, Bull. Ent. Res., XVII, 19, fig. (larva and pupa).
1926. *C. excitans* Kröber, Stett. Ent. Ztg., LXXXVII, 250.
1931. *C. excitans* Philip, Minn. Tech. Bull., LXXX, 85.

The following also refers to this species:

1905. *C. sordidus* Washburn, 10th Rept. State Ent. Minn., p. 79.

Color. Black, with a large, yellow spot on each side of the abdominal dorsum near the base. Abdominal triangles conspicuous or obsolete.

Size. Length, 7 mm. to 12 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae, and a broad longitudinal median stripe on the frontoclypeus, yellow pollinose. Frontal callus, ocellar area, frontoclypeus, and genae black. Scape of antenna yellow; pedicel and base of flagellum reddish brown to yellow; apex of flagellum black. Palpi black. Dorsum of thorax and scutellum black with dense yellowish pubescence, the former with faint grayish pruinose stripes; pleurae and venter gray-yellow pruinose, the former with heavy yellow pile. Dorsum of abdomen black with a yellow lateral spot on each side near the base. The extent of this spot is quite variable; sometimes ending at the hind margin of the second segment and in some large specimens extending beyond the hind margin of the third segment. A middorsal yellow triangle often occurs on the second segment, sometimes on the third and a trace on the fourth; in small specimens there is scarcely a trace of these triangles. Venter of abdomen mostly black, sometimes yellow at the base. Halteres brown. Wings as figured, the crossband and infuscation in cells R and 2d M subject to variation. Legs black; the extreme apices of the front and middle tibiae, the middle and hind metatarsi, yellow. Male: According to Osten Sacken (1875) this sex is entirely black. The thorax with black and some yellowish pubescence intermixed. The black abdomen with some yellow pubescence and a faint gray middorsal triangle on segment II. Infuscation of wings of greater extent in cells R and 2d M. Cell 1st A and the anal angle lightly infuscated.

Comparative Notes. See under description of *C. noctifera* O. S. Separated from *C. sordida* O. S. by the absence of gray hind margins of the abdominal segments.

Remarks. The extreme variation with this species makes description difficult and not seeing large series would tend to make one dubious as to properly placing specimens. Fortunately, I have a series of more than one hundred females from northern Michigan which exhibit all the variations in size and pattern that I have mentioned. Also, see Philip (1931).

Type Data. In two females which were compared with Walker's types in the British Museum by Major Austen, the yellow lateral spot on the dorsum of the abdomen does not extend beyond the posterior margin of the second segment; the middorsal triangles are obsolete.

Distributional Data:

CANADA: Newfoundland 3, July 20 - Aug. 8; Labrador 1, July 12; Ontario 1; Northwest Territory 1, July 15; British Columbia 2, June 11.

UNITED STATES: Maine 5, June - Aug.; Massachusetts 1, May 31; New Hampshire 2; New York 1, July 26; New Jersey 1, May 27; Michigan 6, June 18 - July 14; Wisconsin 2, June 4-22; Minnesota 2, June 15; Colorado; Montana; Washington 1, July 7-30; Oregon 2.

In addition, reported by others from:

CANADA: Quebec, Manitoba.

UNITED STATES: Illinois.

Chrysops facialis Townsend (1897)

(Plate XXXIV, fig. 66; Plate XXXV, fig. 92)

1897. *C. facialis* Townsend, Psyche, VIII, 39.
1904. *C. facialis* Hine, Ohio Nat., V, 223.
1926. *C. facialis* Kröber, Stett. Ent. Ztg., LXXXVII, 261.

Color. Black and yellow, the dorsum of the abdomen with some black more or less geminate figures.

Size. Length, 8 mm.

Structural and Color Characters. Female: Vertex, frons, a narrow stripe on the frontoclypeus, and sides of genae, yellow pollinose. Ocellar area, a line leading from it to the frontal callus, this latter, oral margins of genae, a row of four spots across the frontoclypeus, fuscous to black; remainder of frontoclypeus and palpi reddish to brown. Scape of antenna swollen, the outer surfaces black, inner surfaces yellow; pedicel not so swollen, may be colored like the scape or concolorous with the reddish base of the flagellum; apex of flagellum black; both scape and pedicel with black hairs. Dorsum of thorax and scutellum black, the former with faint gray-yellow stripes; pleurae and venter yellow pollinose with brown stripes, the former with dense yellow pile. Dorsum of abdomen yellow with a black quadrate emarginate spot beneath the scutellum; second and third segments each with a pair of triangular black spots on the disc whose bases are united at the anterior margins of the segment; fourth and fifth segments with a more or less double geminate black spot; remaining segments mostly black; all segments with narrow yellow hind margins. Venter of abdomen yellow with a median row of large quadrate black spots which, toward the apex, extend the full width of the segments; each side with a black stripe, between this and the median row of spots is a dotted black line; all segments with narrow yellow hind margins. Halteres yellow. Wings as figured. Legs yellow; the joints, apices of front tibiae and entire tarsi, apical four segments of the middle and hind tarsi, black. Male: According to Hine (1904): "Colored like the female except more black on legs and wings. In the latter the apical triangle is the same in both sexes, but in each basel cell there is only a small hyaline spot, and the hyaline in the anal cell is much reduced."

Comparative Notes. Separated from others of the group with incrassate antennae by the black frontal callus and four black spots across the frontoclypeus. See remarks.

Remarks. I have seen but two females. The advisability of using the black frontal callus as a character is questionable. In one specimen from Arizona the frontal callus is yellow bordered with black, but conforms in all other respects to the description.

Type Data. Described from one female, West Fork, New Mexico, July 19. In the British Museum. My identification is based on a homotype in the United States National Museum.

Distributional Data:

UNITED STATES: Arizona: Coconino Co., July 1, 1929; Oak Creek Canyon, July.

MEXICO: Chihuahua: Sierra Madre.

In addition, reported by others from:

UNITED STATES: New Mexico.

Chrysops flavida Wiedemann (1821)

(Plate XXXIV, fig. 69; Plate XXXV, fig. 80)

1821. *C. flavidus* Wiedemann, Dipt. Exot., I, 105.
1828. *C. flavidus* Wiedemann, Auss. Zw., I, 199.
1875. *C. flavidus* Osten Sacken, Prodrome, I, 385.
1901. *C. flavidus* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 300.
1901. *C. flavidus* Hine, Ohio Nat., II, 168.
1903. *C. flavidus* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, p. 37.
1906. *C. flavidus* Daecke, Ent. News, XVII, 41.
1907. *C. flavidus* Daecke, Ent. News, XVIII, 146.
1907. *C. flavidus* Hine, Bull. 93, La. Exp. Sta., 29.
1925. *C. flavidus* Hine, Occ. Pap. Mus. Zoöl. U. of Mich., 1762, p. 19.
1926. *C. flavidus* Kröber, Konowia, IV, 329.
1926. *C. flavidus* Kröber, Stett. Ent. Ztg., LXXXVII, 291.
1930. *C. flavidus* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., 14.
1931. *C. flavidus* Schwardt, Jl. Kans. Ent. Soc., IV, 7, larva.

The following also refer to this species:

1848. *C. canifrons* Walker, List, I, 197.
1859. *C. pallidus* Bellardi, Saggio, I, 73, pl. II, f. 16.

Color. Yellow, with brown abdominal pattern.

Size. Length, 7 mm. to 10 mm.

Structural and Color Characters. Female: Variable. Frontal callus, frontoclypeus, genae, and palpi yellow, the usual areas including the ocellar space with yellow pollen. Antennae slightly swollen or not; the scape, pedicel and base of flagellum yellow to brown-yellow, the first two with black pubescence; apex of flagellum black. Thoracic dorsum, pleurae and venter yellow or gray-yellow pollinose with the usual brown stripes; scutellum yellow to brown, or sometimes yellow with a brown spot at the base. Dorsum of abdomen yellow, the second segment with a more or less inverted V-shaped brown figure at the posterior margin; remaining segments with emarginate brown bands which become nearly plain near the apex; posterior margins of the segments caudad from III, yellow. Venter of abdomen yellow at base; anterior margins of apical segments brown, which color may or may not appear in the form of quadrate median spots on segments III, IV, and V; usually traces of brown lateral streaks. Halteres brown. Wings typically as figured, although the extent of infuscation, especially of the apical spot and anal area shows considerable variation. Sometimes the apical spot fades gradually toward the posterior margin of the wing and the crossband fades into the anal area and toward the base of the wing. Daecke (1907) has shown some of these variations. In some specimens the wing picture is nearly similar to that figured for *C. brunnea* Hine. Legs yellow; the joints and distal half of the tibiae and entire tarsi of the front legs, the four distal tarsal segments of the middle and hind legs, brown. Sometimes the hind femora and tibiae are more brown than yellow. Male: Like the female except for sex characters, more densely pilose.

Comparative Notes. See under description of *C. brunnea* Hine. I have some specimens from Florida which superficially resemble *C. pudica* O. S., but the greater extent of the apical spot into cell R_4, the absence of a black spot under the scutellum and the yellow hind femora easily identified them. The male may be confused with the male of *C. cursim* Whit. The wing picture and color of the thoracic dorsum and scutellum will aid in separation.

Remarks. Because of the variation within this species I have taken it out in two places in the key to females. Whether or not the antennae of *C. flavida* are swollen is perhaps a matter of opinion. In most cases the antennae are midway between what is generally considered as distinctly incrassate (*C. pachycera* Will.) and slender (*C. vittata* Wied.).

Type Data. Described from the female from Savannah. In the Museum of Vienna.

Distributional Data:

UNITED STATES: Massachusetts 2, July 15 - Aug. 20; Connecticut 1, June 23-24; New York 1, June 30; New Jersey 1, June 20 - July 19; Delaware 2, July 11-18; Maryland 5, June 16 - Aug. 28; Virginia 4, June 7 - Sept. 8; North Carolina 1, June 10; South Carolina 2, June 7 - Sept. 2; Georgia 1, Aug. 22; Florida 18, Feb. 25 - Nov. 28; Indiana 1, July 23; Alabama 1, Aug.; Illinois 1. May 25 - June 28; Arkansas 3. June 4 - Sept. 15; Louisiana 7, June 16 - Oct. 1; Kansas 1, July 22; Texas 6, March 11 - July 30.

BAHAMA ISLANDS: New Providence, June 30.

CUBA: Havana, June.

In addition, reported by others from:

UNITED STATES: Maine, New Hampshire, Rhode Island, Pennsylvania, Ohio.

MEXICO.

Chrysops frigida Osten Sacken (1875)

(Plate XXXIII, fig. 62)

1875. *C. frigidus* Osten Sacken, Prodrome, I, 384.
1876. *C. frigidus* Osten Sacken, Prodrome, II, 474.
1903. *C. frigidus* Hine, O. State Acad. Sci. Spec. Pap. No. 5, p. 37.
1904. *C. frigidus* Hine, Ohio Nat., V, 223.
1907. *C. frigidus* Daecke, Ent. News, XVIII, 145.
1926. *C. frigidus* Cameron, Bull. Ent. Res., XVII, 20 (larva and pupa), fig.
1926. *C. frigidus* Kröber, Stett. Ent. Ztg., LXXXVII, 330.
1931. *C. frigidus* Philip, Minn. Tech. Bull. LXXX, 86.

The following also refers to this species:

1926. *C. canadensis* Kröber, Stett. Ent. Ztg., LXXXVII, 277.

Color. Black and golden-yellow, extent of both colors extremely variable on both abdomen and legs.

Size. Length, 6.5 mm. to 8 mm.

Structural and Color Characters. Female: Ocellar area, frontal callus, frontoclypeus and oral margins of genae, black; vertex, frons, a streak down the center of the frontoclypeus, sides of genae, yellow pollinose. Antennae with a variable amount of black and yellow on the scape and pedicel, the black usually dominant on the latter; base of flagellum sometimes reddish or yellow, usually the entire flagellum is black. Palpi yellow to yellow brown. Dorsum of thorax and scutellum shining black with some yellowish pruinosity which on the former takes the form of more or less faint stripes; pleurae and venter gray-yellow pruinose with black stripes, the former with bright-yellow pile. Dorsum of abdomen yellow with a black quadrate or trapezoidal spot beneath the scutellum which practically attains the hind margin of the first segment; here it merges with a broader than long, black, more or less pentagonal spot on the second segment emarginate posteriorly. In some specimens the black spot on segment II is rectangular and confined to the anterior margin; however, it is practically always emarginate. Remaining segments predominantly black with yellow hind margins tending to expand into middorsal triangles. Venter of abdomen yellow at the base, the apical segments black with yellow posterior margins; sometimes a black spot is present on the disc of the first two or three basal segments. Halteres yellowish to black. Wings as figured. Legs variable, in some forms predominantly yellow, in others black. In the former, the front coxae, extreme bases and apices of all femora, distal tarsal segments, dark; in the latter, the base of the front tibiae, most of the middle and hind tibiae and metatarsi, yellow. Male: Head as in the female except for sex characters. Thorax more densely yellow pubescent and pilose. Dorsum of abdomen yellow with a median broad black trapezoidal spot on each of the first four segments; remaining segments mostly black; all segments with narrow yellow hind margins. In some specimens the abdominal pattern is much like the female, except the black spots instead of being emarginate posteriorly are more or less produced. Venter of abdomen exhibiting variations as in the female, in one specimen almost entirely black, except for the narrow yellow hind margins of the segments and traces of yellow at the sides near the base. Halteres yellowish to black. Wings with a greater extent of infuscation of cells R and 2d M and in the anal area. Legs variable, usually with more black than in the female.

Comparative Notes. The peculiar abdominal pattern should easily separate this species from others with an apical spot on the wing and black frontoclypeus with a mid-streak of yellow pollen, namely *C. pertinax* Will., *C. amazon* Daecke and *C. noctifera* O. S. In the first two the abdomen is wholly black; in the last, the apical spot includes only the extreme apex of cell R_4, the apex of the hyaline triangle extends beyond vein R_{2+3}, and the yellow of the abdomen is confined to the sides near the base. *C. frigida* is probably close to *C. pilumna* Kröber (assuming this latter to be a distinct species and not an aberrant or teneral *C. frigida*). In Kröber's species the frontoclypeus is yellow, lacking a pollinose midstreak, and the first abdominal tergite is almost completely black. The legs are predominantly yellow.

Remarks. I have had a male specimen of *C. frigida* compared with Kröber's type of *C. canadensis;* except for slight variations, they are identical. Doctor Walley, of the Canadian National Museum, who made the comparisons, states that Kröber's specimen seems slightly teneral, and also adds as follows: "General dorsal abdominal pattern . . . First tergite with median blackish portion a little broader than in your specimen, thus posterolateral paler portions slightly reduced. Second tergite with blackish portion a little broader than your specimen and continued (though slightly less heavily blackish) to apex of tergite, remaining tergites maculate as in your specimen except that blackish bands are more transverse with less tendency to be produced posteriorly in the middle. Frontoclypeus, face, and cheeks agree in color with your specimen. Facets of eyes . . . of two sizes as in your specimen."

Type Data. I have studied the types (five females and "two hypothetical males") in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. Habitat, according to Osten Sacken (1875): Great Slave Lake and Northwestern Regions of the British Possessions; Saskatchewan; Quebec; New York; Massachusetts.

Distributional Data:

CANADA: New Brunswick 1, July 14; Quebec 1, June 16; Manitoba 1, July 16; British Columbia 1, July 18.

UNITED STATES: Maine 1, July 11; New Hampshire 1; Massachusetts 6, June 12 - July; New York 4, June 19 - July 10; Michigan 3, July 1-25; Ohio 1, June 8; Colorado 1, July 22; Washington 1, July 25.

In addition, reported by others from:

CANADA: Newfoundland, Ontario, Saskatchewan.

UNITED STATES: Connecticut, New Jersey, Minnesota, Wisconsin.

Chrysops fuliginosa Wiedemann (1821)

(Plate XXXIII, fig. 60)

1821. *C. fuliginosus* Wiedemann, Dipt. Exot., I, 109.
1926. *C. fuliginosus* Kröber, Stett. Ent. Ztg., LXXXVII, 311.

The following also refer to this species:

1828. *C. plangens* Wiedemann, Auss. Zw., I, 210.
1875. *C. plangens* Osten Sacken, Prodrome, 1, 393.
1906. *C. plangens* Daecke, Ent. News, XVII, 42.
1907. *C. plangens* Daecke, Ent. News, XVIII, 141.

Color. Gray-black or brown; infuscation of wings not very saturate, usually a distinct spot at the bifurcation of vein R_{4+5}.

Size. Length, 6 mm. to 7.5 mm.

Structural and Color Characters. Female: Vertex, frons, and sides of genae yellow pollinose; ocellar space, frontal callus sides of frontoclypeus, oral margins of genae, and palpi, fuscous; frontoclypeus and basal segments of antennae yellow to brown-yellow; apical segments of flagellum black; sometimes the scape and pedicel considerably darkened. Dorsum of thorax and scutellum fuscous with yellowish pubescence, the former with obscure grayish to gray-yellow pollinose stripes; pleurae and venter grayish pollinose with brown stripes, the former with more or less fulvous pile. Dorsum of abdomen gray-brown, all segments with narrow yellowish hind margins; the dark color on the discs of the first three or four segments more pronounced and forming obscure but definite geminate spots. Venter of abdomen gray-brown with very narrow yellowish hind margins to the segments. Halteres brown. Wings as figured; a faint tooth-like projection from the crossband to the bifurcation of vein R_{4+5} present or absent. Legs brown; the extreme base of the front tibiae, most of the median tibiae, sometimes the basal portion of the hind tibiae, the median and hind metatarsi, yellow. Male: Darker than the female. Antennae fuscous. Pile of the pleurae black. Abdomen fuscous. The wings more extensively infuscated; the apex of the hyaline triangle beyond vein R_{4+5} represented by a mere hyaline streak; a small hyaline dot near the apices of cells R and 2d M. Legs much like the female but with a little more brown.

Comparative Notes. Separated from *C. brimleyi* Hine by the greater extent of the apical spot of the wings, and the infuscated spot at the bifurcation of vein R_{4+5}.

Type Data. Described from a male, "Aus Nordamerika," In the Museum of Vienna. A female described as *C. plangens,* Savannah, Georgia, presumably in the University of Berlin. Kröber (1926) in his description of *C. fuliginosa* states that a female from Savannah designated as the type is in the University of Berlin, but does not say whether it is labeled *C. fuliginosa* or *C. plangens.*

Distributional Data:

UNITED STATES: Massachusetts 3, June 13-25; Rhode Island 1, June; Connecticut; New York 3, June 5-29; New Jersey 2, May 28 - June 11; Delaware 1, May 26; Virginia 1, May 14; North Carolina; South Carolina 2, May 28; Georgia 2; Florida 4, March 16 - April 17.

CANADA: Nova Scotia.

UNITED STATES: Maine.

Chrysops fulvastra Osten Sacken (1877)

(Plate XXXIV, fig. 70; Plate XXXV, fig. 90)

1877. *C. fulvaster* Osten Sacken, West. Dipt., p. 221.
1887. *C. fulvaster* Williston, Trans. Kans. Acad. Sci., X, 134.
1904. *C. fulvaster* Hine, Ohio Nat., V, 223.
1924. *C. fulvaster* Wehr, Neb. Univ. Studies, XXII, 112.
1926. *C. fulvaster* Cameron, Bull. Ent. Res., XVII, 21 (larva and pupa), fig.
1931. *C. fulvaster* Philip, Minn. Tech. Bull., LXXX, 86.
1926. *Heterochrysops fulvaster* Kröber, Stett. Ent. Ztg., LXXXVII, 233.
1928. *H. fulvaster* Kröber, Deutsche Ent. Ztsch., p. 427.

The following also refers to this species:

1892. *C. coloradensis* Bigot, Mem. Soc. Zoöl. France, V, 605, (partim).

Color. Female: Fuscous or brown with gray-yellow abdominal triangles; wing picture fenestrate. Male: mostly black or fuscous, abdominal triangles much reduced; wings much more infuscated.

Size. Length, 6 mm. to 8 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae and a mid-streak on the frontoclypeus yellow pollinose; upper margin of frontal callus, a small spot on each side of the frontoclypeus, another on the oral margin of the genae, fuscous; disc of frontal callus, remainder of frontoclypeus and genae, and the palpi, yellow. Antennae decidedly incrassate, the scape most strongly; flagellum scarcely longer than the scape; the scape, pedicel, and base of flagellum brown-yellow to brown, sometimes the outer surfaces of the first two, and always the apex of the flagellum, black. Dorsum of thorax and scutellum brown or yellow-brown pruinose, the former with fuscous stripes; pleurae and venter gray-yellow pollinose with the usual brown stripes. Dorsum of abdomen yellowish or gray-yellow with a black spot beneath the scutellum; second segment with a median pair of oblique black spots, sometimes nearly united at the anterior margin to form a geminate spot; remaining segments black with yellowish posterolateral angles and hind margins which expand to form middorsal triangles. Venter of abdomen gray-yellow, each segment with a large fuscous quadrate median spot which apically occupies nearly the whole width of a segment; hind margins of all segments gray-yellow; fuscous lateral stripes usually present. Halteres yellow. Wings as figured. Legs orange-yellow; the joints, front tarsi, and apical three or four segments of the middle and hind tarsi, fuscous. Male: Predominantly black. Antennae and palpi black. Thorax similar to female but with a greater extent of black. Dorsum of abdomen black; all segments with yellowish posterolateral angles and narrow hind margins which expand into very small middorsal triangles. Wings with all cells included by the picture more extensively infuscated than in the female, but the general pattern is the same, and should cause no difficulty in associating the two sexes. Legs practically like the female, except the front legs which are wholly black except the base of the tibiae, and the hind femora sometimes are black at the base.

Comparative Notes. This species is distinct and should not be easily confused with others of the group with swollen antennae. From *C. discalis* Will. it may at once be separated by the antennae; from *C. coquilletti* Hine, and *C. clavicornis* n. sp. by the fenestrate discal cell and abdominal pattern; from *C. latifrons* n. sp. by the abdominal pattern and absence of a tooth-like projection of the crossband, as well as a greater extent of the apical spot.

Type Data. Described from five females and one male from Colorado and Utah. I have studied these types at the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

United States: North Dakota 1, June 30 - July; South Dakota 6, June 15 - July 16; Nebraska 1, May; Kansas 4, June - July 26; Oklahoma 1, July 19; Montana 2, July 14-16; Wyoming 5, June 22 - Aug. 12; Colorado 18, June 4 - Aug. 14; New Mexico 4, June 22 - July 29; Idaho 2, July 6-25; Utah 12, June 18 - Aug. 14; Arizona 3, July 2 - Aug. 15; California 1.

In addition, reported by others from:

Canada: Saskatchewan, Alberta.
United States: Minnesota.

Chrysops fulvistigma Hine (1904)

(Plate XXX, fig. 13)

1904. *C. fulvistigma* Hine, Can. Ent., XXXVI, 55.
1907. *C. fulvistigma* Daecke, Ent. News, XVIII, 146.
1907. *C. fulvistigma* Hine, Bull. 93, La. Exp. Sta., p. 29.
1926. *C. fulvistigma* Kröber, Stett. Ent. Ztg., LXXXVII, 248.

Color. Black and yellow, the latter color predominant on the two basal abdominal segments. Wing picture extremely dilute, so that the wings appear to be almost hyaline with a prominent yellowish stigma and yellow veins.

Size. Length, 6.5 mm. to 7 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae, a few streaks on the frontoclypeus, yellow pollinose; frontal callus, frontoclypeus and oral margins of the genae, black. Palpi and scape of antenna yellow; pedicel and first segment of flagellum yellow-brown; apical four segments of flagellum black. Dorsum of thorax and scutellum fuscous with grayish pruinosity, the former faintly striped; pleurae and venter yellow pollinose with brown stripes. Dorsum of abdomen black and yellow as follows: First segment yellow with a quadrate emarginate black spot beneath the scutellum, attaining the posterior margin; second segment yellow with a black posterior margin which on the disc sends out two finger-like processes which almost reach the anterior margin (in one specimen the median figure on segment II is solid black); third segment black with a small yellow median spot at the anterior margin and on each side a smaller yellow spot; remaining segments black. Venter of abdomen with the first two segments yellow; the third yellow with a large quadrate black spot on the disc; remaining segments black. Halteres brown. Wings as figured. Legs brown; front coxae, base of femora and tibiae, apex of middle femora, entire tibiae and metatarsi, base of hind tibiae and metatarsi, yellow. Male: Like the female in all respects except for sex characters; very easily associated.

Comparative Notes. The unusual abdominal pattern and the wings will easily distinguish this species from all others included in this paper.

Remarks. This is the first time that the male has been reported.

Type Data. I have studied the types in the Hine collection at the Ohio State Museum. Described from two females taken at Raleigh, North Carolina, July 15 and 17, 1902.

Distributional Data:

UNITED STATES: North Carolina: Raleigh, June 11, 1906; June 17, 1907. Georgia: Decatur Co., June 7-23, 1911. Louisiana: Osborn, July 19, 1906.

In addition, reported by others from:

UNITED STATES: New Jersey.

Chrysops furcata Walker (1848)

(Plate XXXI, fig. 37; Plate XXXVII, fig. 114)

1848. *C. furcatus* Walker, List, I, 199.
1904. *C. furcatus* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 302.

The following also refer to this species:

1904. *C. lupus* Whitney, Can. Ent., XXXVI, 205.
1904. *C. lupus* Hine, Ohio Nat., V, 224.
1926. *C. lupus* Kröber, Stett. Ent. Ztg., LXXXVII, 304.
1931. *C. lupus* Philip, Minn. Tech. Bull., LXXX, 88.

Color. Black and yellow.

Size. Length, 9 mm. to 10 mm.

Structural and Color Characters. Female: Vertex gray to gray-yellow pollinose; frons and sides of genae yellow pollinose; ocellar area, frontal callus, a spot on each side of the frontoclypeus, oral margin of genae, black; frontoclypeus and palpi yellow, the latter with a little black on the outer surfaces; antennae black; the basal portion of the scape and sometimes the inner surface of the pedicel, yellow. Thoracic dorsum and scutellum fuscous, yellowish pubescent, the former with gray-pollinose stripes; pleurae and venter yellowish pollinose with the usual fuscous stripes, the former with heavy yellow pile. Dorsum of abdomen yellow; a quadrate black spot beneath the scutellum, barely emarginate posteriorly, practically attaining a pentagonal geminate spot on the disc of the second segment; segments III, IV and V each with four black more or less triangular spots whose bases rest on the anterior margin where they tend to be united; remaining segments black with yellow hind margins. Venter of abdomen yellow; first segment with a black spot on the disc which usually continues on to the second segment; second segment with a small black spot on the disc; segments III, IV and V each with a median black quadrate spot; remaining segments black with yellow hind margins; the usual black lateral streaks present. Halteres brown. Wings as figured; the apex of the hyaline triangle distinctly exceeding vein R_{2+3}; the extent of infuscation in cells R and 2d M variable. Legs black and yellow, the former distributed as follows: the joints, front femora, tibiae and tarsi, except the extreme base of the tibiae and the inner surfaces of the femora, bases of middle and hind femora, apical portions of hind tibiae, and middle and hind tarsi. Sometimes the yellow is more prevalent, especially on the basal portions the front femora and tibiae and the apical portion of the hind tibiae. Male: Philip (1931) reports one male from Montana, but does not describe it. I have not seen this sex.

Comparative Notes. This species is related to *C. coloradensis* Bigot and *C. montana* O. S. From the former it is readily separated by the different abdominal pattern, the black frontal callus and the black on each side of the frontoclypeus and on the oral margin of the genae; from the latter, by the greater extent of the hyaline triangle on the wing and the apical spot occupying only the apex of cell R_4, and again by the black on each side of the frontoclypeus and on the oral margin of the genae. *C. furcata* is very apt to be confused with *C. proclivis* O. S., but this latter has cell R of the wings completely infuscated and on the second abdominal tergite a small black spot on each side of the median geminate spot.

Remarks. The synonymy is based on a homotype in Hine's collection and Walker's description. The *C. furcatus* of Hine (1904), Kröber (1926) and in the key of Philip (1931) is a large form of *C. montana* O. S. which may deserve varietal rank. I have seen Hine's series. I fail to see how these authors were justified in referring to the facial callosities and cheeks as yellow, for Walker (1848) states: "Head yellow, slightly hoary behind, with two piceous tubercles above, ferruginous and shining in front between the feelers and the mouth, where there are also two piceous shining spots on each side . . . ."

Type Data. In the British Museum. Described from specimens from St. Martin's Falls, Albany River and Hudson Bay. Whitney's types of *C. lupus* are in very poor condition. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

CANADA: New Brunswick 1, July 27; Manitoba 2, July 9-21; Alberta 2, May 7 - July 22; British Columbia 3, June 12 - July 15.

UNITED STATES: South Dakota 1, July 19; Montana 5, June 23 - Aug. 14; Wyoming 3, June 27 - Aug. 18; Oregon 2, July 10-20; California 1, May 15-19; Alaska 2, July 4.

In addition, reported by others from:

UNITED STATES: Michigan, Minnesota.

Chrysops geminata Wiedemann (1928)

(Plate XXXII, fig. 45)

1828. *C. geminatus* Wiedemann, Auss. Zw., I, 205.
1926. *C. geminatus* Kröber, Stett. Ent. Ztg., LXXXVII, 299 (syn.).

The following also refer to this species:

1875. *C. fallax* Osten Sacken, Prodrome, I, 392.
1903. *C. fallax* Hine, Ohio State Acad. Sci. Spec. Pap. No. 5, p. 36.
1906. *C. fallax* Daecke, Ent. News, XVII, 40, 41.
1907. *C. fallax* Daecke, Ent. News, XVIII, 141.
1918. *C. fallax* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.

Color. Yellow with black abdominal pattern.

Size. Length, 6.5 mm. to 7.5 mm.

Structural and Color Characters. Female: Frontal callus, ocellar area, the pit on each side of the frontoclypeus, and spot on the oral margin of the genae, black; frontoclypeus, genae, and palpi, yellow; the usual areas yellow pollinose. Scape of antenna yellow; pedicel and base of flagellum yellow-brown; apex of flagellum black. Dorsum of thorax, pleurae and venter gray-yellow to yellow pruinose; the usual stripes and the scutellum fuscous. Dorsum of abdomen yellow with a black spot beneath the scutellum; the second segment with a pair of small black oblique spots on the disc, not reaching either margin; segments III, IV and V mostly black with yellow hind margins and a median yellow stripe; remaining segments black with yellow hind margins. Sometimes the black on each side of the yellow median stripe of segments III, IV and V is again partly cut by yellow, so that these segments are yellow with four black spots. Venter of abdomen yellow at the base with a quadrate black median spot on segments III and IV. The apical segments black with yellow hind margins; the usual black lateral streaks present. Halteres brown. Wings as figured. Legs black; the front coxae and basal two thirds of femora and base of tibiae, apical half of middle femora and entire tibiae and metatarsi, base of hind tibiae, and metatarsi, yellow. Male: Similar to the female except for sex characters and a bit more infuscation at the apices of cells R and 2d M. Sometimes the median spots on the second abdominal tergite are practically united anteriorly.

Comparative Notes. Related to *C. lateralis* Wied., from which it may be separated by the apical spot occupying most of cell R_4, the crossband attaining the hind margin of the wing, and the black spots of the second abdominal tergite not reaching the hind margin. In addition, *C. lateralis* is a generally larger species.

Remarks. With respect to the synonymy of *C. geminata* Wied. and *C. fallax* O. S. I prefer to follow Kröber, who has studied Wiedemann's type and compared it with "eine sec-Type" of *C. fallax*. A question of doubt exists, however, inasmuch as Wiedemann gives as the type locality, "Vaterland?" and Kröber states the type to be "stark verschmiert."

Type Data. One female in the Museum of Vienna. I have seen Osten Sacken's types of *C. fallax* at the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: Massachusetts 5, July 4-25; Connecticut; New York 3, July 1 - Aug. 1; New Jersey 5, June - July 7; Pennsylvania 3, June 26 - July 15; Maryland 3, June 18 - July 9; Virginia 1; South Carolina 1, June; Ohio 5, June 7 - Aug. 1; Tennessee 1, Aug. 3; Illinois 1.

In addition, reported by others from:

CANADA: Quebec, Ontario.

UNITED STATES: New Hampshire, Vermont, Delaware, North Carolina, Georgia.

Chrysops geminata impuncta Kröber (1926)

1926. *C. geminatus* Wied. var. *impunctus* Kröber, Stett. Ent. Ztg., LXXXVII, 301.

Color. Yellow with black abdominal pattern.

Size. Length, 6.5 mm. to 7 mm.

Structural and Color Characters. Female: Similar to *C. geminata* Wied. except for the total absence of black on the first and second abdominal segments. Legs yellow; apical portion of front tibiae and entire tarsi, distal four segments of the middle and hind tarsi, base of hind femora and apex of tibiae, fuscous. Wings as figured for *C. geminata*. Male: Like the female except for sex characters.

Comparative Notes. Separated from *C. geminata* Wied. by the absence of the black spots on the second abdominal tergite. Doctor Walley of the Canadian National Museum compared one of my specimens with Kröber's type concerning which he states: "Size: very slightly larger than your specimen. Length, 6.5 mm. Abdominal pattern . . . First and second tergities identical with your specimen except that first tergite has only a very faint trace of brownish at middle of anterior margin. Third tergite with a small median pale triangle, the apex of which scarcely attains the posterior margin. Fourth tergite with narrow, obscure median stripe. Fifth tergite without pale median stripe."

Type Data. Type No. 1341, Canadian National Collection, Ottawa.

Distributional Data:

UNITED STATES: Maryland: Catonsville, June 30, 1922. Ohio: Medina Co., July 19, 1903, Aug. 1, 1901; Ira.

In addition, reported by others from:

CANADA: Ontario: Port Stanley; Ottawa; Guelph.

Chrysops hinei Daecke (1907)

(Plate XXXIII, fig. 55)

1907. *C. hinei* Daecke, Ent. News, XVIII, 143.
1926. *C. hinei* Kröber, Stett. Ent. Ztg., LXXXVII, 338.

Color. Yellow with black longitudinal stripes.

Size. Length, 7 mm. to 8.5 mm.

Structural and Color Characters. Female: Vertex gray-yellow pollinose, frons and sides of genae yellow pollinose; frontal callus yellow, margined above with brown; frontoclypeus, genae, palpi, and scape of antenna yellow; pedicel and base of flagellum yellow-brown, the apex of the latter fuscous to black. Dorsum of thorax and scutellum brown, the former with grayish stripes, the latter sometimes yellow at the tip; pleurae and venter yellow pollinose with brown stripes. Dorsum of abdomen yellow with four longitudinal black stripes, the lateral ones broken or incomplete, extending toward the base rarely beyond the posterior margin of the second segment; the last two segments almost entirely black. Venter of abdomen yellow with a broad, black median stripe, not attaining the base; two black lateral streaks present; apical segments mostly black. Halteres brown. Wings as figured, the long narrow hyaline triangle characteristic. Legs yellow; apical portion of front tibiae and entire tarsi, base of hind femora and apex of tibiae, apical four segments of middle and hind tarsi, brown. Male: Not identified. Daecke (1907) mentions a hypothetical specimen from Clementon, New Jersey, September 7, 1905, but defers description for want of evidence.

Comparative Notes. To be separated from related species according to the key. The narrow hyaline triangle due to the broad posterior extent of the apical spot along with the yellow frontal callus and incomplete lateral stripes on the abdominal dorsum easily distinguishes this species.

Type Data. Described from seventeen females, all from New Jersey. I have studied the cotypes in the United States National Museum and at the Ohio State Museum.

Distributional Data:

UNITED STATES: New Jersey: Lakehurst, Sept. 4; Weymouth, Aug. 16, 1904. South Carolina: Plantersville, Sept. 20, 1912; Allendale, Sept. 15, 1931. Georgia: Mimsville, Sept. 12, 1907. Florida: Alachua Co., Nov. 18, 1929; Cambon, Sept. 20, 1925.

In addition, reported by others from:

UNITED STATES: Massachusetts, North Carolina.

Chrysops hungerfordi, new species

(Plate XXXVI, fig. 100)

Color. Tawny yellow with black abdominal pattern; wing picture saturate.

Size. Length, 6.5 mm. to 8 mm.

Structural and Color Characters. Female: Vertex broader than long, yellow pollinose; frons, a mid-streak on the frontoclypeus and sides of genae yellow pollinose; frontal callus, frontoclypeus, oral margins of genae, and palpi, yellow; antennae incrassate, the scape prominently swollen, yellow except the black apex of the flagellum, often the upper and outer sides of the scape and pedicel, black. Dorsum of thorax and scutellum yellow-gray pollinose, white pubescent, the former with obscure stripes; pleurae and venter yellow-gray pruinose, sparsely white pilose. Dorsum of abdomen tawny yellow; a black spot beneath the scutellum deeply incised posteriorly, attaining or not, the hind margin of the first segment; second segment with a median black geminate figure or with two black angular spots divergent posteriorly; segments III to VI each with a median pair of black angular spots whose bases are directed anteriorly, and small black irregular lateral spots; sometimes the black figures on segments III to V are united near the anterior margins or form double geminate spots; seventh segment and sometimes also the sixth mostly black with yellow hind margins. Venter of abdomen yellow or tawny with a black median stripe and usual lateral stripes; the two apical segments almost entirely black except for the yellow hind margins. Halteres yellow. Wings as figured. Legs yellow, the joints, apical portion of front tibiae and entire tarsi, the four apical segments of the middle and hind tarsi, and rarely the extremities of the hind tibiae, black. Male: In addition to sex characters it differs from the female in the dorsal abdominal pattern and the wing picture. Dorsum of abdomen dominantly black, the first segment wholly black except for the narrow yellow posterolateral angles and a minute yellow median spot on the posterior margin; second segment yellow with a heavy black median geminate figure, on each side of which is a small black spot; segments III to V yellow, each with a black double geminate figure whose median paired spots are the larger; remaining segments black with narrow yellow hind margins. The wing picture differs from that of the female primarily in the greater extent of infuscation in cell M which is nearly equal to that of cell R.

Comparative Notes. *C. coquilletti* Hine and *C. pachycera* Will. are the nearest relatives of this species. From *C. coquilletti,* the female of *C. hungerfordi* may be separated by the infuscation in the basal part of cell M which ends rather abruptly, and by the black median figure on the second abdominal tergite, which is smaller and often composed of two spots; the males are easily separated by the dorsal abdominal patterns, no lateral spots on the second segment in *C. coquilletti,* etc., also the infuscation of cell M being nearly equal to that of cell R in *C. hungerfordi* offers further proof of their separateness. The wing picture of *C. hungerfordi* is very similar to that of *C. pachycera* in both sexes; however, the dorsal abdominal patterns are different. In the female of *C. hungerfordi* black lateral spots are always present caudad from segment III, whereas in *C. pachycera* it is the rule that these spots are absent; the males are readily separated by the presence of black lateral spots on segment II in *C. hungerfordi.*

Remarks. The three species considered under "Comparative Notes" have many affinities, each exhibiting more or less variation. Any one may be justly confused with another, especially in the females. Careful discrimination and judgment is required to separate them. By means of the males, however, separation is greatly facilitated.

Type Data. Holotype, female; Blue Spring, Eddy Co., New Mexico, July 12, 1933, J. M. Brennan. Allotype, male; same data. Paratypes, one male, same data; one male, Eddy Co., New Mexico, July 9, 1927, P. A. Readio; one male, San Bernardino Ranch, Cochise Co., Arizona, August, F. H. Snow; nine females, same data as holotype. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

NOTE. This species is named for Dr. H. B. Hungerford through whose inspiration the author has been stimulated to enter into the field of systematic entomology.

Chrysops hyalina Shannon (1924)

1924. *C. hyalinus* Shannon, Proc. Ent. Soc. Wash., XXVI, 178.
1930. *C. hyalinus* Bequaert, Rept. Harvard-African Exped., etc., p. 890.

The following also refer to this species:

1916. *C. vitripennis* Shannon, Ins. Ins. Menst., IV, 69, (preoc.).
1918. *C. vitripennis* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 198.
1926. *Nemorius claripennis* Kröber, Stett. Ent. Ztg., LXXXVII, 230.

Color. Black, with hyaline wings.

Size. Length, 5.5 mm. to 6 mm.

Structural and Color Characters. Female: Vertex black with sparse whitish pubescence, at the base of the antennae some white pollen; frons and sides of genae whitish pollinose. Frontal callus, frontoclypeus, genae, and palpi, black. Antennae slender, mostly black, except the scape, which is light-brown pollinose. Thorax and abdomen shining black with pale pile and pubescence in the usual regions. Halteres black. Wings hyaline except the yellowish costal area and stigma; veins yellow. Legs black; the middle and hind metatarsi pale. Male: Unknown.

Comparative Notes. This is the only described species in this country without a wing picture, and hence quite distinct. Its nearest relative is *C. nigribimbo* Whit., from which it differs in general color, vertex, frontoclypeus, wings and legs.

Remarks. According to McAtee by Shannon (1926) the habits of *C. hyalina* are quite different from those of *C. nigribimbo*. The former has been taken only in sphagnum bogs; it perches on low vegetation, and flies slowly and feebly but a short distance at a time.

Type Data. Described from four females, all from Beltsville, Maryland. I have studied the type (No. 21301) in the United States National Museum.

Distributional Data. Reported from Beltsville, Maryland. Kröber (1926) adds Southern Pines, North Carolina.

Chrysops inda Osten Sacken (1875)

(Plate XXXII, fig. 49)

1875. *C. indus* Osten Sacken, Prodrome, I, 383.
1901. *C. indus* Hine, Ohio Nat., II, 168.
1903. *C. indus* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, p. 38.
1906. *C. indus* Daecke, Ent. News, XVII, 42.
1907. *C. indus* Daecke, Ent. News, XVIII, 141.
1920. *C. indus* Marchand, Mon. Rock. Inst. No. 13, p. 48.
1926. *C. indus* Kröber, Stett. Ent. Ztg., LXXXVII, 326.
1930. *C. indus* Stone, Ann. Ent. Soc. Am., XXIII, 282.
1931. *C. indus* Philip, Minn. Tech. Bull., LXXX, 87.

Color. Black and yellow, the former dominant in the dorsal abdominal pattern, especially in the male.

Size. Length, 6 mm. to 10 mm.

Structural and Color Characters. Female: Vertex and sides of genae yellow pollinose; frontal callus black; frontoclypeus, genae, and palpi, orange-yellow; antennae rather thick; the scape yellow, pedicel and base of flagellum reddish, apex of the latter black. Often the distal ends of both scape and pedicel are darker than their bases. Dorsum of thorax and scutellum gray pruinose, with yellow pubescence, the former with brown stripes, the latter with the brown ground color distinctly showing through; pleurae and venter gray-yellow pollinose with the usual brown stripes, the former with fulvous pile. The yellow of the abdominal dorsum with a black spot beneath the scutellum, emarginate on the hind margin of the first segment; a black geminate or inverted U-shaped spot on the disc of the second segment, practically attaining both margins; third and fourth segments black with yellow hind margins which expand into long narrow median triangles whose apices are broadly open at the anterior margins; remaining segments black with yellow hind margins. Frequently the yellow of the first two segments continues posteriorly on the sides of segments III and IV. Venter of abdomen mostly yellow, the last three segments black with yellow hind margins; the usual black lateral streaks. Halteres brown. Wings as figured. Legs orange-yellow; all the trochanters, apex of front tibiae and entire tarsi, apical four segments of the middle and hind tarsi, extreme apex of hind femora, black. Male: Much darker than the female. Dorsum of thorax and scutellum mostly black, the former with faint grayish pollinose stripes; pleurae with black pile. Dorsum of abdomen black; the posterolateral angles of the first segment, the sides and a very small posteromedian triangle on segments II, III and IV, the narrow posterior margins of all segments caudad from III, yellow. Venter of abdomen yellow, the first three segments each with a median broad, black quadrate spot, the remaining segments black with yellow hind margins; the black lateral stripes are quite broad and practically attain the base. Wings like the female, but that cell 2d M is completely infuscated except a small hyaline spot near the apex, and cell 1st A and the anal angle are infuscated, the latter dilutely. Legs yellow; all the joints, basal portions of all femora, apical portion of front tibiae and entire tarsi, apical segments of middle and hind tarsi, black.

Comparative Notes. The abdominal pattern in both sexes of this species is distinct; this along with the wing picture will easily separate *C. inda* from others of its group. It has no close relatives. Osten Sacken (1875) states that it is "very like *C. pudicus, montanus, hilaris,* . . ."

Type Data. Described from two females from Cayuga Lake, New York and Montreal. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

Canada: Quebec 1, June 20; Ontario 1, June 23.

United States: New Hampshire 2, July 5-16; New York 5, June 14 - July 29; New Jersey 1, June 18; Delaware 1, June 10; Pennsylvania 3, June 12 - July 1; Michigan 2, July 3 - Aug. 4; Ohio 9, May 22 - July 13; Indiana 1, June; Illinois 4, June 15 - July 8; Minnesota 3, June 14 - July 6; Colorado 1, July 15-18.

In addition, reported by others from:

United States: Vermont, Massachusetts, Connecticut, North Carolina, Wisconsin.

Chrysops lateralis Wiedemann (1828)

(Plate XXXII, fig. 46)

1828. *C. lateralis* Wiedemann, Auss. Zw., I, 209.
1926. *C. lateralis* Kröber, Stett. Ent. Ztg., LXXXVII, 302 (syn.).

The following also refer to this species:

1875. *C. hilaris* Osten Sacken, Prodrome, I, 391.
1902. *C. hilaris* Howard, Ins. Book, pl. XVI, f. 17.

Color. Yellow, with black abdominal pattern.

Size. Length, 7.5 mm. to 9 mm.

Structural and Color Characters. Female: Vertex gray-yellow pollinose; frons and sides of genae yellow pollinose; frontal callus, a spot on each side of the frontoclypeus, oral margins of genae, black; frontoclypeus, palpi, scape of antenna, yellow; apical portion of flagellum black. Dorsum of thorax and scutellum brown or plumbeus, the former with the usual grayish pollinose stripes; pleurae and venter yellow pollinose with brown stripes. Dorsum of abdomen yellow with two small black spots beneath the scutellum which do not quite extend to the posterior margin of the first segment; second segment with a median pair of vittate black spots which often attain the posterior margin and sometimes apparently the anterior margin; third and fourth segments each with two more or less quadrate black lateral spots through the center of which the yellow ground color shows; (sometimes these black spots are so completely separated by the yellow ground color that segments III and IV may be said to be yellow with four black spots); remaining segments black with yellow posterior margins, frequently the yellow of segment V incises the black on the disc, but does not attain the anterior margin. Venter of abdomen yellow; segments III, IV and V with a quadrate black median spot; remaining segments black with yellow posterior margins; the usual black lateral streaks extend toward the base not beyond the posterior margin of the second segment. Halteres fuscous. Wings as figured; the apical spot separated from the crossband; the latter not quite attaining the hind margin. Legs yellow; the joints, apical portion of front tibiae and entire tarsi, basal portion of hind femora and sometimes apical portion of hind tibiae, apical four segments of middle and hind tarsi, black. Male: Much like the female except for sex characters. On the dorsum of the abdomen, the pair of black spots beneath the scutellum is larger; a small median black spot is present on each of segments I and II of the abdominal venter. Wings like the female except for a dilute infuscation in the cubital and anal areas. Legs generally exhibiting more black, especially on the hind femora and tibiae, and the apices of the middle and hind metatarsi.

Comparative Notes. Related to *C. geminata* Wied. from which it may be separated by its larger size, the crossband of the wing not attaining the hind margin, and the black spots on the second abdominal tergite usually attaining the hind margin.

Remarks. I accept the synonymy of Kröber (1926). He has seen Wiedemann's type and has evidently compared specimens from this country determined as *C. hilaris* O. S.

Type Data. Female, locality doubtful, in the Museum of Vienna. I have studied the Osten Sacken types of *C. hilaris* at the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

CANADA: New Brunswick 1, July 12; Quebec 2, July 1-23.

UNITED STATES: Maine 1, June 25; New Hampshire 5, July 5-20; Vermont 1, Aug. 1; Massachusetts 1, July 14; New York 8, June 30 - Aug. 1.

In addition, reported by others from:

CANADA: Nova Scotia, Ontario.

UNITED STATES: Connecticut, New Jersey, Pennsylvania, ?Kansas.

Chrysops latifrons, new species

(Plate XXIX, fig. 4; Plate XXXIV, fig. 74; Plate XXXV, fig. 93)

Color. Yellow with black abdominal pattern; appendages yellow; crossband of wing broken by hyaline areas.

Size. Length, 7 mm.

Structural and Color Characters. Female: Entire head and its appendages yellow, except the eyes, proboscis and apical portion of the flagellum; a brown area may appear about the ocelli; the usual areas with yellow pollen. Scape of antenna much swollen, the pedicel just a little. Dorsum of thorax and scutellum yellow, the former with obscure brown stripes; pleural and sternal regions yellowish pollinose with faint brown stripes. Dorsum of abdomen yellow with a quadrate black spot under the scutellum which nearly attains the posterior margin of the first segment; segments II, III and IV with a black geminate spot, on each side of which may appear a small black spot; remaining segments black; all posterior margins yellow. Venter of abdomen yellow with a median black stripe and two lateral ones. Wings as figured. Legs yellow; apical portion of front tibiae and entire tarsi, apical tarsal segments of middle and hindlegs, and all joints, brown. Male: Predominantly black. Head and its appendages as in the female except for sex characters. Thoracic region more brown. First abdominal segment black except the yellow lateroposterior margin; second with a large black trapezoidal spot encroached upon from the posterior margin by a yellow triangle, the yellow on each side with a small black spot; segments III, IV and V almost entirely black with a double geminate figure; remaining segments black; all segments with narrow yellow posterior margins. Venter of abdomen like the female. Wings similar to the female, except the infuscation of cell 2d M is equal to that of cell R; cell 1st A infuscated at the base. Legs as described for the female except that the front femora and hind tibiae show some brown at the apices.

Comparative Notes. Related to *C. pachycera* Will., from which it may easily be separated by the toothlike prolongation of the crossband which attains the bifurcation of vein R_{4+5}.

Type Data. Holotype, female; Fairbanks Ranch, Ash Meadows, 2,300 feet; Amargosa Desert, Nevada; (R and H); August 17, 1919. Allotype, male; Owens, Nevada; Clark county, August 23, 1919; 3,000 feet. Paratypes, one female same data as holotype; one female, same data as allotype.

All specimens received from the Philadelphia Academy of Natural Science. Holotype, allotype and one paratype to be deposited there; one paratype in the Francis Huntington Snow Entomological Collection of the University of Kansas.

Chrysops lugens Wiedemann (1821)

(Plate XXXIII, fig. 54)

1821. *C. lugens* Wiedemann, Dipt. Exot., I, 109.
1828. *C. lugens* Wiedemann, Auss. Zw., I, 212.
1903. *C. lugens* Hine, Ohio State Acad. Sci. Spec. Pap. No. 5, p. 39.
1907. *C. lugens* Daecke, Ent. News, XVIII, 142.
1907. *C. lugens* Hine, Bull. 93, La. Exp. Sta., 30.
1926. *C. lugens* Kröber, Stett. Ent. Ztg., LXXXVII, 315.

Color. Fuscous, sometimes with a faint grayish middorsal abdominal stripe.

Size. Length, 6.5 mm. to 8 mm.

Structural and Color Characters. Female: Vertex gray-yellow pollinose; frons and sides of genae yellow pollinose; ocellar area, frontal callus, a line connecting them, sides of frontoclypeus, oral margins of genae, and palpi fuscous; remainder of frontoclypeus and basal segments of antennae yellow or brown-yellow; flagellum mostly black. Thoracic dorsum and scutellum fuscous, the former with grayish pollinose stripes; pleurae and venter fuscous with the usual gray yellow pruinosity. Abdomen fuscous; sometimes the dorsum with a faint grayish mid-stripe and the venter with a little gray yellow on the sides near the base. Halteres fuscous. Wings as figured. Legs yellow, the trochanters, base of front tibiae and entire tarsi, bases of middle and hind femora, apex of hind tibiae, apical segments of middle and hind tarsi, fuscous. Male: Similar to the female except for sex characters. The male of Hine (1903) with the broad yellow thoracic stripes may be *C. obsoleta* Wied.

Comparative Notes. The wing picture is much like that of *C. parvula* Daecke except that the apical spot more nearly approximates the posterior margin. The generally larger size of *C. lugens* and the dominant yellow of the hind femora and tibiae readily separate it from *C. parvula.*

Type Data. Described from a male specimen from Savannah. In the Vienna Museum. Kröber (1926) states that there is no specimen recognizable as the type.

Distributional Data:

UNITED STATES: Connecticut 1, June 30; Maryland 12, May 5-July 10; District of Columbia 1, July 3; Virginia 6, June 18-July 13; North Carolina; Georgia 1, Aug. 3; Florida 4, Feb. 25-Aug. 19; Alabama 1, July 21; Illinois 1, Aug. 27.

In addition, reported by others from:

UNITED STATES: New York, New Jersey, Ohio, Louisiana.

Chrysops mitis Osten Sacken (1875)

(Plate XXX, fig. 18)

1875. *C. mitis* Osten Sacken, Prodrome, I, 374.
1904. *C. mitis* Hine, Ohio Nat., V, 224.
1907. *C. mitis* Daecke, Ent. News, XVIII, 140.
1926. *C. mitis* Kröber, Stett. Ent. Ztg., LXXXVII, 247.
1926. *C. mitis* Cameron, Bull. Ent. Res., XVII, 22.
1931. *C. mitis* Philip, Minn. Tech. Bull., LXXX, 89.

Color. Black.

Size. Length, 8.5 mm. to 11 mm.

Structural and Color Characters. Female: Vertex, frons, a midstreak on the frontoclypeus, sides of genae, gray pollinose; ocellar area, frontal callus, frontoclypeus, oral region of genae and palpi, black; scape, basal portion of pedicel, and base of flagellum red yellow; remainder of antennae black. Dorsum of thorax and scutellum black, pale pubescent, the former with faint gray stripes; pleurae and venter black, the former with dense gray-yellow pile except for the black pile of the humeri. Abdomen black with light and dark pubescence intermixed; small gray middorsal triangles on segments II, III and IV. Halteres black. Wings as figured; extent of infuscation in cells R and 2d M, and the cubital area variable. Legs black; bases of median and posterior metatarsi red yellow. Male: Like the female except for sex characters. The gray pubescence and pile replaced by black.

Comparative Notes. Generally more robust than *C. carbonaria* Walker, from which it may also be separated by the infuscation at the base of cell Cu_1 of the wing. See under description of *C. carbonaria.*

Type Data. Described from nine females from British Possessions in North America from Canada to the Mackenzie and Yukon rivers and Lake Superior. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

CANADA: Quebec 2, May 25 - July 3; Manitoba 1, June 10; Northwest Territory 1, July 15-28.

UNITED STATES: New Hampshire 1; New York 1; Wisconsin 2, May 26 - June 22; Illinois 1, June 15; Minnesota 4, June 24 - July 16; North Dakota 3, June 18-21; Montana 2, Aug.; Wyoming 1, July 12-30; Colorado 3, June 30; Idaho 5, July; Washington 1; Oregon 1.

In addition, reported by others from:

CANADA: Labrador, Ontario, Saskatchewan, Alberta, British Columbia.
UNITED STATES: Maine, Vermont, Massachusetts, New Jersey?, Utah.

Chrysops moecha Osten Sacken (1875)

(Plate XXXIII, fig. 59)

1875. *C. moechus* Osten Sacken, Prodrome, I, 387.
1901. *C. moechus* Hine, Ohio Nat., II, 168.
1903. *C. moechus* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, p. 39.
1906. *C. moechus* Daecke, Ent. News, XVII, 40.
1907. *C. moechus* Daecke, Ent. News, XVIII, 141.
1907. *C. moechus* Hine, Bull. 93, La. Exp. Sta., p. 31.
1918. *C. moechus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1920. *C. moechus* Marchand, Mon. Rock. Inst. No. 13, p. 49.
1926. *C. moechus* Kröber, Stett. Ent. Ztg., LXXXVII, 332.
1930. *C. moechus* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., 14.
1930. *C. moechus* Stone, Ann. Ent. Soc. Am., XXIII, 283.
1931. *C. moechus* Philip, Minn. Tech. Bull., LXXX, 89.

Color. Female, yellow with black abdominal stripes; male, black.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Vertex, frons, and sides of genae, yellow pollinose; frontal callus and a spot on the oral margin of the genae black; frontoclypeus, remainder of genae, and palpi, yellow; scape and pedicel of antenna yellow, flagellum, except base, black. Rarely, the frontal callus is yellowish. Dorsum of thorax green-gray pruinose with brown stripes; scutellum yellow with a green-gray or brown spot on the disc; pleurae and venter yellow with the usual brown stripes. Dorsum of abdomen yellow with two broken black median stripes extending from segment V almost to the anterior margin of II, on which segment they often converge; on each side a broken black stripe from segment V to segment III or II; a small black spot beneath the scutellum; segments VI and VII black. Venter of abdomen yellow; the usual lateral streaks and the apical two or three segments, black. Halteres fuscous. Wings as figured; the very small hyaline triangle not exceeding vein M_1 is characteristic. Legs yellow; trochanters, apical portion of anterior tibiae and entire tarsi, basal portion of posterior femora, apices of median and posterior tarsi, black. Male: Much different than the female, but readily associated by the hyaline triangle of the wing. Antennae, sides of frontoclypeus, oral margin of genae, and palpi, black. Whole body, except traces of gray-yellow pruinose stripes on the thoracic dorsum and pleurae, and a touch of yellow on the sides of the abdomen, black. Wings entirely infuscated except the small hyaline triangle and a tiny spot near the apices of cells R and 2d M; the cubital and anal areas more dilute. Legs black; base of anterior tibiae, apex of median femora and entire tibiae; median and posterior metatarsi brown yellow.

Comparative Notes. The females may be mistaken for *C. univittata* Macq., but the characteristic wing picture with the reduced hyaline triangle should easily separate this species. The superlative degree of melanism in the males of *C. moecha* makes them totally different from this sex in *C. univittata.*

Type Data. Described from the District of Columbia, Georgia, Kentucky and Missouri. Two females and one male in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

United States: Massachusetts 1, June 28; Connecticut 1, Aug. 8; New York 1, July 30; New Jersey 3, July 2 - Aug. 4; Delaware 1, June 10; Maryland 11, June 3 - Aug. 11; District of Columbia 1, June 8; Virginia 3, June 14 - July 31; North Carolina 1, Aug. 13; Georgia 1, June 7; Pennsylvania 2, June 15-27; Michigan; Ohio 5, June 10 - July 14; Tennessee 1, June 4; Illinois 4, June 2-28; Mississippi 2, July 15 - Aug. 15; Arkansas 1, July 9; Kansas 1; Oklahoma 2, May 23-24.

In addition, reported by others from:

Canada: Quebec.

United States: Maine, New Hampshire, West Virginia, Kentucky, Minnesota, Missouri, Louisiana.

Chrysops montana Osten Sacken (1875)

(Plate XXXI, fig. 28)

1875. *C. montanus* Osten Sacken, Prodrome, I, 382.
1895. *C. montanus* Townsend, Trans. Am. Ent. Soc., XXII, 57.
1903. *C. montanus* Hine, Ohio State Acad. Sci. Spec. Pap. No. 5, p. 40.
1906. *C. montanus* Daecke, Ent. News, XVII, 41.
1907. *C. montanus* Daecke, Ent. News, XVIII, 145.
1918. *C. montanus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1926. *C. montanus* Kröber, Stett. Ent. Ztg., LXXXVII, 298.
1930. *C. montanus* Stone, Ann. Ent. Soc. Am., XXIII, 284.
1931. *C. montanus* Philip. Minn. Tech. Bull., LXXX, 90.

The following also refer to this species:

1904. *C. furcatus* Hine, Ohio Nat., V, 222.
1926. *C. furcatus* Kröber, Stett. Ent. Ztg., LXXXVII, 296.

Color. Yellow with black abdominal pattern.

Size. Length, 7.5 mm. to 10 mm.

Structural and Color Characters. Female: Vertex, frons and sides of genae gray yellow to yellow pollinose; frontal callus black, rarely yellowish; frontoclypeus, oral margin of genae, and palpi, yellow; scape, pedicel and base of flagellum yellow to brown-yellow; apical portion of flagellum black. Dorsum of thorax and scutellum dark brown or plumbeus, the former with the usual grayish pollinose stripes; pleurae and venter gray-yellow pollinose with fuscous stripes. Dorsum of abdomen yellow; a black quadrate spot beneath the scutellum emarginate posteriorly; the second segment with a median geminate or inverted V-shaped black figure, on each side of which is a small black spot; segments III, IV and V with four black spots which attain the anterior but not the posterior margins; sometimes segment V, along with the remaining segments, is black, only the posterior margins yellow. Venter of abdomen yellow; a median black spot on each of segments III, IV and V; sometimes also on I and II; remaining segments black with yellow posterior margins; the usual black lateral streaks present. Halteres fuscous. Wings as figured; sometimes the apical spot includes barely more than the apex of cell R_4 and the extent of infuscation in cell R is variable, in some cases nearly the whole cell being colored. Legs yellow; the trochanters, apex of front tibiae and entire tarsi, base of hind femora, apices of middle and hind tarsi, black. Male: Differs from the female throughout by a greater display of fuscous. Dorsum of thorax and scutellum fuscous, the former with obscure yellowish stripes. Dorsum of abdomen similar to female except the median figures on segments II and IV are heavy black geminate spots. Cells R and 2d M of wing infuscated except at extreme apices, light infuscation prevails in anal area of wing. Legs as in female except the base of front femora and apex of hind tibiae, black.

Comparative Notes. Osten Sacken (1875) relates this species to his *C. pudica*, but I fail to see any resemblances except in the wing picture. Philip (1931) states that some specimens of *C. montana*, especially where cell R is infuscated for more than half its total area, are near *C. striata* O. S., but the more extensive apical spot of the latter should easily separate the two. The abdominal pattern of *C. montana* resembles that of some specimens of *C. lateralis* Wied., but the wing pictures are totally different. Also, see under description of *C. furcata* Walker.

Remarks. As indicated in my description of *C. furcata* Walker, there is a large form of *C. montana* O. S. which Hine (1904) and Kröber (1926) identified as *C. furcata;* however, the latter author was doubtful. I have seen such specimens and there are no marked differences between them and the typical *C. montana* except that they are more robust. I lack sufficient evidence to raise this form to varietal rank.

Type Data. Described from two females from Catskill Mountain House, New York, July, 1874, and one female from Ogle county, Illinois. I have studied the types, in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

CANADA: Quebec 1, Aug. 8; Ontario 1.

UNITED STATES: New Hampshire 1, July 16; Massachusetts 3, July 28 - Aug.; New York 1, Aug. 4; New Jersey 3, June 21 - July 9; District of Columbia 1, June 7; Michigan 2, June 29 - July 25; Ohio 4, June 15-19; Indiana 1, July 23; Illinois 2, July 8 - Aug. 25; Minnesota 3, July 5-9.

In addition, reported by others from:

UNITED STATES: Vermont, Connecticut, Virginia, North Carolina, Louisiana.

Chrysops nigra Macquart (1838)

(Plate XXX, fig. 16)

1838. *C. niger* Macquart, Dipt. Exot., I, 1, p. 161.
1875. *C. niger* Osten Sacken, Prodrome, I, 377.
1895. *C. niger* Townsend, Trans. Am. Ent. Soc., XXII, 57.
1895. *C. niger* Hart, Bull. Ill. State Lab. N. H., IV.
1901. *C. niger* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 301.
1902. *C. niger* Howard, Ins. Book, pl. XV, f. 36.
1903. *C. niger* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, p. 41.
1906. *C. niger* Daecke, Ent. News, XVII, 41.
1907. *C. niger* Daecke, Ent. News, XVIII, 140.
1918. *C. niger* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1926. *C. niger* Kröber, Stett. Ent. Ztg., LXXXVII, 241.
1928. *C. niger* Kröber, Deutsche Ent. Ztsch., p. 429.
1930. *C. niger* Stone, Ann. Ent. Soc. Am., XXIII, 285.
1930. *C. niger* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., 13.
1931. *C. niger* Schwardt, Jl. Kans. Ent. Soc., IV, 8.
1931. *C. niger* Philip, Minn. Tech. Bull., LXXX, 91.

The following also refers to this species:

1848. *C. carbonarius* Walker, List, I, 203 (in part).

Color. Black.

Size. Length, 6.5 mm. to 8.5 mm. Philip (1931) gives 7.5 mm. to 10 mm.

Structural and Color Characters. Female: Vertex gray pollinose; frons and sides of genae yellow pollinose; ocellar area, frontal callus, a spot on each side of the frontoclypeus, oral margin of genae, and palpi, fuscous to black; frontoclypeus and scape of antenna yellow; pedicel and base of flagellum brown-yellow; apex of flagellum black. Dorsum of thorax and scutellum black, white pubescent, the former with gray pollinose stripes; pleurae and venter gray pruinose with the usual black stripes, the former with whitish pile. Abdomen entirely black with white pubescence. Halteres black. Wings as figured. Legs black; base of anterior tibiae, basal half of median tibiae, median and posterior metatarsi, yellow. In some specimens the legs are completely black except the yellow median and posterior metatarsi. Male: Similar to the female except for sex characters. Cell 2d M of wing is mostly infuscated except a small hyaline spot near the apex; cubital and anal areas dilutely infuscated.

Comparative Notes. The yellow frontoclypeus and hyaline cell 2d M readily separates this species from all others of the group lacking an apical spot. The male is apt to be confused with that of *C. carbonaria* Walker, but also in this case the frontoclypeus offers the best character.

Type Data. Described from "Amerique du Nord." In the Museum of Lille.

Distributional Data:

CANADA: Ontario 1, July 31.

UNITED STATES: Maine 2, June 21; New Hampshire 3, July 7-12; Massachusetts 3, June 1-20; Rhode Island 1; Connecticut 1, June 20-23; New York 6, June 10 - July 19; New Jersey 5, May 20 - June 25; Delaware 2, June 6-9; Maryland 5, May 19 - June 16; District of Columbia 1, May 21-30; Virginia 6, May 23 - June 10; North Carolina 1, May 20; Pennsylvania 9, May 17 - July 12; Michigan; Ohio 7, May 23 - Aug. 23; Indiana 1, May 27 - June 15; Wisconsin 1, June; Illinois 4, May 10 - June 5; Missouri 1; Arkansas 1, June 7-11.

In addition, reported by others from:

CANADA: Newfoundland, Nova Scotia, Quebec.

UNITED STATES: Minnesota, Montana.

Chrysops nigribimbo Whitney (1879)

(Plate XXX, fig. 17)

1879. *C. nigribimbo* Whitney, Can. Ent., XI, 35.
1906. *C. nigribimbo* Daecke, Ent. News, XVII, 41.
1907. *C. nigribimbo* Daecke, Ent. News, XVIII, 141.

Color. Fuscous; crossband of wing obsolete.

Size. Length, 5.5 mm. to 7 mm.

Structural and Color Characters. Female: Vertex, frons and sides of genae gray pollinose; ocellar area, frontal callus, a spot on each side of the frontoclypeus, another on the oral margin of the genae, fuscous; palpi and scape of antenna yellow, the latter often with some fuscous; pedicel and base of flagellum brown-yellow; apical portion of flagellum black. Entire body fuscous, white pubescent; the pleurae with the usual gray pruinosity and white pile. Halteres fuscous. Wings as figured, the picture very dilute, almost obsolete, most saturate along the costal margin and the stigma. Legs fuscous; front coxae, proximal portion of front tibiae, middle and hind metatarsi and sometimes the middle femora and tibiae, brown-yellow. Male: Like the female in all respects except for sex characters. The head is relatively quite large.

Comparative Notes. This species is distinct from all others in our North American fauna. It is most closely related to *C. hyalina* Shan., but may at once be separated by the presence of a wing picture. See under description of *C. hyalina.*

Remarks. To my knowledge this is the first time the male has been described.

Type Data. Described from Milford, New Hampshire. I have studied the types. Four females in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: New Hampshire 1; Rhode Island 1; New York 1, June 30; New Jersey 1, June 21 - Aug. 15; North Carolina 1, May 16 - June 22; Florida 1.

In addition, reported by others from:

UNITED STATES: Massachusetts.

Chrysops nigripes Zetterstedt (1838)

(Plate XXXI, fig. 36)

1838. *C. nigripes* Zetterstedt, Ins. Lapp., p. 519.
1842. *C. nigripes* Zetterstedt, Dipt. Scand., I, 125.
1858. *C. nigripes* Loew, Verh. Z. B. Ges. Wien., p. 623.
1875. *C. nigripes* Osten Sacken, Prodrome I, 394.
1904. *C. nigripes* Hine, Ohio Nat., V, 224.
1923. *C. nigripes* Hine, Can. Ent., LV, 145.
1926. *C. nigripes* Kröber, Stett. Ent. Ztg., LXXXVII, 323.

Color. Black, abdominal tergites with gray hind margins which expand into median triangles.

Size. Length, 8 mm. to 10 mm.

Structural and Color Characters. Female: Vertex, frons, a mid-streak on the frontoclypeus, sides of genae, gray pollinose; frontal callus, frontoclypeus, oral margins of genae, palpi, and antennae, fuscous to black; sometimes the inner surfaces of the basal antennal segments are reddish. Dorsum of thorax and scutellum black, pale-yellow pubescent, the former with gray-pollinose stripes; pleurae and venter black with a gray pruinosity, the former with pale-yellow pile and a trace of black pile on the humeri. Dorsum of abdomen black; first segment with posterolateral angles and the very narrow hind margin gray yellow; the black of the second segment is encroached upon from each side by gray yellow; all segments caudad from II with conspicuous gray hind margins which on II to V expand into middorsal triangles. Venter of abdomen black, the segments with gray hind margins; a small patch of yellow on each side near the base usually present. Halteres fuscous. Wings as figured; the tooth-like projection of the crossband characteristic. Legs black; the base of the front tibiae, middle and hind metatarsi, brown. Male: According to Kröber (1926), who has redescribed this species from European specimens, this sex differs from the female as follows: The dorsum of the thorax lacks the gray stripes; the pleurae are black pilose; the gray hind margins of the abdominal tergites do not expand into triangles; there is a greater extent of infuscation in cells R and 2d M of the wings.

Comparative Notes. This species has no close American relatives. From both *C. noctifera* O. S. and *C. pertinax* Will. it is readily distinguished by the conspicuous gray hind margins of the abdominal tergites which in the female expand into median triangles, and by the tooth-like projection of the crossband of the wing.

Remarks. This species is the only European Chrysops undoubtedly represented in boreal North America.

Type Data. One female. In the Museum of Lund.

Distributional Data:

CANADA: Manitoba: Kettle Rapids, near Winnipeg, July 16, 1917.

UNITED STATES: Maine: Saddleback Lake, July 18-20, 1916. Montana: Lakeview, Aug. 4, 1920. Alaska: Nenana, July 5-7, 1921; Anchorage, July 21, 1921; Savonoski, Naknek Lake, Aug. 5, 1919; Fairbanks, June 30, 1921; Kukak Bay, July 4, 1899.

Chrysops noctifera Osten Sacken (1877)

(Plate XXX, fig. 23)

1877. *C. noctifer* Osten Sacken, West Dipt., p. 220.
1904. *C. noctifer* Hine, Ohio Nat., V, 224 (*C. pertinax* Will. a syn.).
1927. *C. noctifer* Cole, Proc. Cal. Acad. Sci., XVI, 420 and 469, f. 72.

The following also refers to this species:

1927. *Chrysops sp.* near *sordidus* Essig, Pan. Pac. Ent., IV, 186.

Color. Shining black, dorsum of abdomen with a yellow spot on each side near the base.

Size. Length, 8 mm. to 9.5 mm.

Structural and Color Characters. Female: Vertex, frontal callus, frontoclypeus, and genae, black; sides of vertex, frons, a mid-streak on the frontoclypeus, and sides of genae, gray-yellow pollinose. Antennae slender; scape and pedicel yellowish, flagellum mostly black, slightly thicker than the scape. Palpi and proboscis red-brown. Dorsum of thorax and scutellum black with whitish pubescence, the former with obscure gray stripes; pleurae and venter black, the former with dense grayish-yellow pile and some black pile on the humeri. Dorsum of abdomen black, encroached upon anterolaterally by two large yellow spots; faint grayish middorsal triangles sometimes visible on segments II, III and IV. Venter of abdomen black with a greater extent of yellow anterolaterally. Wings as figured; the apical spot narrow and practically separated from the crossband which does not reach the posterior margin of the wing. Legs black; base of tibiae, median and posterior metatarsi, red-brown; anterior coxae and posterior femora with long whitish hair. Male: To my knowledge this sex has not been reported.

Comparative Notes. Separated from *C. pertinax* Will. principally by the yellow lateral spots on the abdomen. Taken by series, *C. noctifera* is smaller than *C. pertinax.* I have seen specimens of *C. excitans* Walker with a trace of an apical spot which might easily be confused with *C. noctifera,* but in this instance the geographic distribution of these species will aid in separation.

Type Data. Described from four females, Sierra county, California, July 20, 27. I have studied the types in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: California: Sacramento, June 4, 1915; Fallen Leaf, July 15, 1917; Sonoma Co.; Fallen Leaf Lake; Lake Tahoe, June 12-30, 1930, June 28, 1931; Tahoe, June 10-16, 1916; Truckee, July 16, 1916; Echo Lake, Aug. 22, 1927.

In addition, reported by others from:

UNITED STATES: New Mexico.

Chrysops obsoleta Wiedemann (1821)

(Plate XXXIII, fig. 50)

1821. *C. obsoletus* Wiedemann, Dipt. Exot., p. 108.
1828. *C. obsoletus* Wiedemann, Auss. Zw., I, 211.
1926. *C. obsoletus* Kröber, Stett. Ent. Ztg., LXXXVII, 315.

The following also refer to this species:

?1838. *C. trinotatus* Macquart, Dipt. Exot., 1, 1, 161.
1875. *C. morosus* Osten Sacken, Prodrome I, 389.
1903. *C. lugens* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, p. 39 (in part).
1907. *C. lugens* Hine, Bull. 93, La. Exp. Sta., p. 30 (in part).
1907. *C. lugens morosus* Daecke, Ent. News, XVIII, 142.

Color. Fuscous; abdominal dorsum with three more or less obsolete yellow stripes.

Size. Length, 7.5 mm. to 8.5 mm.

Structural and Color Characters. Female: Vertex gray-yellow pollinose; frons and sides of genae yellow pollinose; ocellar area, frontal callus, a spot on each side of the frontoclypeus, another on each side of the oral margin of the genae, and palpi, fuscous; remainder of frontoclypeus and genae brown-yellow; scape of antenna yellow, pedicel and base of flagellum brown-yellow, apex of flagellum black. Dorsum of thorax and scutellum fuscous, the former with gray to gray-yellow pollinose stripes, the latter sometimes yellowish near the tip; pleurae and venter yellow pollinose with the usual fuscous stripes. Dorsum of abdomen fuscous with three more or less obscure yellow stripes which begin near the base and fade out near the apex, their length variable. Venter of abdomen fuscous with a variable amount of yellow on the sides near the base. Halteres fuscous. Wings as figured; cell R completely infuscated, the cubital and anal areas hyaline or dilutely infuscated. Legs yellow; joints, apical portion of front tibiae and entire tarsi, bases of middle and hind femora, sometimes the apex of the hind tibiae, apical segments of middle and hind tarsi, fuscous. Male: Similar to the female except for sex characters. Wiedemann (1928) states that the abdomen lacks stripes. Kröber (1926) states that the male designated as the type is much greased. Osten Sacken (1875) in his description of *C. morosus* states that the male in its essential character is like the female and that the three yellow abdominal stripes are very distinct.

Comparative Notes. Separated from *C. lugens* Wied. by the three yellow abdominal stripes and the more arcuate and narrow hyaline triangle of the wing. The wing picture is much like that of *C. ultima* Whit., but that species has the abdomen almost entirely fuscous and the pleural stripes are gray pollinose. From *C. parvula* Daecke, *C. obsoleta* is distinguished by the abdominal stripes, the wing picture, the dominance of yellow on the hind legs, and its generally larger size. *C. wiedemanni* Kröber, the *C. obsoletus* of authors, is an entirely different fly, at once distinguished from *C. obsoleta* Wied. by the hyaline cell 2d M.

Remarks. The characters used for separating *C. obsoleta, C. lugens, C. ultima,* and *C. parvula* must be employed with care, for these are all very close. In large series the characters most readily discernible intergrade. It is quite probable that future work may bring some of these species into synonymy.

Type Data. Through the courtesy of the Museum of Vienna, I received one type female (Savannah) for study. It is in excellent condition, slightly faded, and unfortunately the hind legs are missing. However, the fundamental characters are well preserved.

Distributional Data:

UNITED STATES: New Jersey 1, July 28; Delaware 2, July 14-24; Maryland 3, June 13 - July 31; District of Columbia 1, July 7; North Carolina 1, May 26; Ohio I.

In addition, reported by others from:

UNITED STATES: Massachusetts, Connecticut, New York, Georgia, Florida, Pennsylvania, Louisiana.

Chrysops ornata Kröber (1926)

1926. *C. ornatus* Kröber, Stett. Ent. Ztg., LXXXVII, 328.

I have not been able to identify this species. It belongs in Kröber's "Gruppe *vittatus*." According to description, the length is 8.5 mm. Frontal callus and frontoclypeus yellow; antennae slender. Thorax with the usual yellowish pollinose and brown stripes; scutellum yellow. The pattern of the abdominal dorsum is peculiar; the black cruciform median spot on the fourth tergite seems characteristic. The wing picture is not markedly different from that of *C. vittata* Wied. Legs yellow with the usual fuscous areas.

Described from one female, Jordan, Ontario. In Kröber's collection.

Chrysops pachycera Williston (1887)

(Plate XXXIV, fig. 68; Plate XXXV, fig. 91; Plate XXXVII, figs. 108, 109)

1887. *C. pachycera* Williston, Trans. Kans. Acad. Sci., X, 134.
1895. *C. pachycera* Townsend, Proc. Cal. Acad. Sci., ser. 2, IV, 596.
1903. *C. pachycera* Adams, Kans. Univ. Sci. Bull., II, 442 (Type ♂ = *C. proclivis* O. S.).
1904. *C. pachycera* Hine, Ohio Nat., V, 224.
1926. *C. pachycera* Kröber, Stett. Ent. Ztg., LXXXVII, 264.

Color. Yellow, with black abdominal pattern.

Size. Length, 6.5 mm. to 8 mm.

Structural and Color Characters. Female: Vertex broader than long, yellow pollinose; frontal callus, frontoclypeus, genae, and palpi yellow, the usual areas pollinosed; sometimes a small spot on the oral margins of the genae and the upper border of the frontal callus, brown; antennae incrassate, especially the scape, mostly yellow or brown-yellow except for the black apical portion of the flagellum; scape and pedicel with coarse black pubescence. Dorsum of thorax and scutellum typically yellow-gray pollinose with whitish pubescence, the former with the usual dark stripes; pleurae and venter yellow pollinose, some brown ground color showing through. Dorsum of abdomen yellow; a black quadrate spot beneath the scutellum, posteriorly emarginate, not attaining the hind margin of the first segment; second segment with a small median black geminate figure (sometimes this figure assumes the form of two divergent spots) which attains neither margin; segments II to VI each with a median pair of black subtriangular spots whose bases are directed anteriorly; segment VII usually black with a yellow hind margin, sometimes the sixth segment approaches this condition; rarely, obscure black lateral spots are present on all segments caudad from III. Venter yellow with a narrow black median stripe and a lateral stripe running full length; apical two or three segments black with yellow hind margins. Halteres yellow. Wings as figured; sometimes the crossband is fenestrate. Legs yellow; joints, apex of front tibiae and entire tarsi, apical segments of middle and hind tarsi, black. Male: Head like the female except for sex characters. Dorsum of thorax and scutellum more brown. Dorsum of abdomen yellow; the black spot beneath the scutellum more extensive than in the female; segments II and III each with a heavy median geminate black spot; remaining segments much like the female; the sixth typically with a black lateral spot. Venter of abdomen like the female. Wings like the female, except for a greater extent of infuscation in cells R and 2d M, that of 2d M being about equal to R. Legs very similar to the female.

Comparative Notes. Closely related to *C. latifrons* n. sp., but that species is easily distinguished by the tooth-like projection of the crossband. *C. pachycera* is smaller and predominantly more yellow than *C. coquilletti* Hine. See, also, under description of *C. coquilletti.* The presence or absence of infuscation at the base of cell 1st A in the male (a character mentioned in most of the literature) appears to be of no taxonomic value. See description of *C. hungerfordi* n. sp.

Remarks. The characters used by Hine (1904) in his key are not very satisfactory for separating *C. pachycera* from *C. coquilletti,* although the species are very distinct. To make matters worse, Kröber (1926) in his key has absolutely reversed the characters used by Hine.

Type Data. Unfortunately the types have disappeared. Described from three specimens from California, the male of which has proved to be *C. proclivis* O. S.

Distributional Data:

UNITED STATES: Utah: Zion National Park, Aug. 13, 1929; Pintura, Aug. 11, 1929; St. George, June 5-7, 1919, June 2, 1928. Arizona: Bill Williams Fork, August; Lewis Springs, Aug. 5, 1907; Dripping Springs, Aug. 31, 1920.

MEXICO: Lower California.

In addition, reported by others from:

UNITED STATES: Oregon.

Chrysops parvula Daecke (1907)

(Plate XXXIII, fig. 51)

1907. *C. parvulus* Daecke, Ent. News, XVIII, 142.
1918. *C. parvulus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1926. *C. parvulus* Kröber, Stett. Ent. Ztg., LXXXVII, 314.
1930. *C. parvulus* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., 13.

The following also refers to this species:

1875. *C. morosus* Osten Sacken, Prodrome I, 390 (in part).

Color. Fuscous.

Size. Length, 5.5 mm. to 7 mm.

Structural and Color Characters. Female: Vertex and sides of genae gray-yellow pollinose; ocellar area, frontal callus, a line connecting them, a large spot on each side of the frontoclypeus, oral margins of genae, and palpi, fuscous; the disc of the frontoclypeus usually brown-yellow; sometimes, however, this region is entirely fuscous; antennae slender; scape and pedicel, and sometimes the extreme base of the black flagellum, yellow to brown-yellow. Thorax and scutellum fuscous, the former with faint gray pollinose stripes; pleurae and venter gray-yellow pollinose with the usual fuscous stripes. Abdomen entirely fuscous. Halteres fuscous. Wings are figured; the apex of the hyaline triangle not attaining vein R_{2+3} and the apical spot not often exceeding vein R_5. Legs yellow; the trochanters, apex of front femora, apical three fourths of front tibiae and entire tarsi, base of middle femora, most of the hind femora and tibiae, except at their extreme apex and base, respectively, apical segments of middle and hind tarsi, fuscous. Male: This sex has never been reported, unless one is to accept the male with the wholly brown abdomen mentioned by Osten Sacken (1875) under his description of *C. morosus*.

Comparative Notes. This species is no doubt the smallest of its group and is distinguished by its fuscous abdomen and typically fuscous hind femora and tibiae. See, also, under description of *C. lugens* Wied.

Remarks. Daecke (1907) offers an additional means of separating *C. parvula* from *C. lugens* by the eye pattern. The former having the frontal spot usually excised anteriorly and the occipital border separated from the occiput, the latter with a solid frontal spot and the occipital border connected with the occiput.

Type Data. Described from a large series, most of them from Bamber, New Jersey, July 9, 1906. I have studied the types in the United States National Museum.

Distributional Data:

UNITED STATES: New Jersey: Lakehurst, July 2-3, 1912, July 25; Bamber, July 9, 1906; Jersey City; Rawlins, Aug. 11, 1907; Hammondton, June 27, 1933. Florida: Hilliard, Aug. 19, 1930. Arkansas: Washington Co., Aug. 16, 1929; Fayetteville, Aug. 12, 1929.

In addition, reported by others from:

UNITED STATES: North Carolina.

Chrysops pertinax Williston (1887)

(Plate XXX, fig. 24)

1887. *C. pertinax* Williston, Trans. Kans. Acad. Sci., X, 132.
1901. *C. pertinax* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 307.

The following also refers to this species:

1892. *C. nigriventris* Bigot, Mem. Soc. Zoöl. France, V, 604.
1926. *C. noctifer* Kröber, Stett. Ent. Ztg., LXXXVII, 308.

Color. Black.

Size. Length, 8.5 mm. to 11 mm.

Structural and Color Characters. Female: Vertex gray pollinose; frons, a mid-streak on the frontoclypeus, and sides of genae, yellowish pollinose; ocellar area, frontal callus, frontoclypeus, oral margins of genae, palpi, and proboscis, black; antennae variable, usually black except for some yellow at the basal portion of the scape; sometimes the bases of the pedicel and flagellum are red-brown. Dorsum of thorax and scutellum black with light-gray pubescence, the former with faint gray pollinose stripes; pleurae and venter black, the former with dense yellowish-gray pile and on the humeri black pile. Abdomen black, white pubescent with some black intermixed; tergites II to IV often with grayish mid-dorsal triangles. Halteres black. Wings as figured; some variation in the extent of infuscation in cells R and 2d M. Legs black; the middle and hind metatarsi, and sometimes the extreme bases of all the tibiae, red-brown. Male: Like the female except for sex characters. Antennae wholly black. Entire body black, the pubescence and pile brown or black. Wings with a greater extent of infuscation in cells R and 2d M. Legs similar to the female.

Comparative Notes. See under description of *C. noctifera* O. S. Superficially the species resembles *C. mitis* O. S., but the presence of an apical spot immediately distinguished *C. pertinax.*

Remarks. I am taking this species out of synonymy because I fail to find any intergrading forms. I have studied both Osten Sacken's types of *C. noctifera* and Williston's types of *C. pertinax,* and in addition, large series of both species. In very few specimens of *C. pertinax* I have observed just a faint trace of yellow on the sides of the abdomen near the base. This species is more robust and is principally northwestern in distribution. I have no records of *C. noctifera* north of California. Kröber described the male under *C. noctifera.*

Type Data. Described from eight females from Washington Territory, of which two cotypes (one of which I am designating and labeling as the lectotype) remain in the Francis Huntington Snow Entomological Collection of the University of Kansas.

Distributional Data:

CANADA: Alberta 1, July 3 - Aug. 23; British Columbia 4, May 9 - June 25.

UNITED STATES: Michigan 1, July 4; Montana 3, June 27 - Aug. 14; Wyoming 2, July 18 - Aug. 18; Utah 3, June 23 - July 26; Idaho 2, June 8 - July 10; Washington 14, May 26 - Aug. 5; Oregon 10, July 10-26; California 2, May 20-25.

In addition, reported by others from:

CANADA: Ontario.

Chrysops pikei Whitney (1904)

(Plate XXXII, fig. 47)

1904. *C. pikei* Whitney, Can. Ent., XXXVI, 205.
1904. *C. pikei* Hine, Ohio Nat., V, 224.
1907. *C. pikei* Hine, Bull. 93, La. Exp. Sta., 33.
1924. *C. pikei* Wehr, Neb. Univ. Studies, XXII, 113.
1926. *C. pikei* Kröber, Stett. Ent. Ztg., LXXXVII, 336.
1930. *C. pikei* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., 13.
1931. *C. pikei* Schwardt, Jl. Kans. Ent. Soc., IV, 9.

Color. Yellow and black, abdomen vittate.

Size. Length, 6.5 mm. to 8 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae, yellow pollinose; frontal callus black; frontoclypeus, oral margins of genae and palpi, yellow, sometimes a black spot on the oral margin of the genae and each side of the frontoclypeus; antennae slender; scape, pedicel and base of flagellum yellow; apex of flagellum black. Dorsum of thorax gray-yellow pruinose with fuscous stripes; scutellum yellow with a fuscous spot on the disc (usually a continuation of the median stripe of the thoracic dorsum); pleurae and venter yellow pollinose with the usual fuscous stripes. Abdominal dorsum yellow with four longitudinal black stripes, the lateral ones extending toward the base not beyond the posterior margin of the second tergite. Venter of abdomen yellow; usually a small median black spot on each of segments III, IV and V; remaining segments black with yellow hind margins; the usual lateral streaks present. Halteres black. Wings as figured; the hyaline triangle broadly open, its apex not exceeding vein R_{2+3}. Legs yellow; apical portion of front tibiae and entire tarsi, middle and hind coxae, trochanters, and apical tarsal segments, black. Male: Like the female except for sex characters. The fuscous stripes of the thoracic and abdominal dorsum are broader. Apical abdominal segments black.

Comparative Notes. A distinct species. Usually separated from the more variable *C. sequax* Will. by the incomplete lateral abdominal stripes and the hyaline triangle of the wing, which is more broadly open. The males of these species are quite distinct.

Type Data. Described from eleven females, Pike county, Missouri.

Distributional Data:

UNITED STATES: New Jersey 1; North Carolina 1, May 30; Ohio 17, May 30 - Aug. 21; Indiana 4, June 15 - Sept. 22; Alabama 1, July 22; Illinois 7, June 7 - July 23; Mississippi 1, July 15; Iowa 1, June 17; Arkansas 2, May 2 - June 27; Louisiana 6, April - Sept. 6; Kansas 23, June 3 - Aug. 27; Oklahoma 2, May 23-24; Texas 3, April 26 - May 12.

In addition, reported by others from:

UNITED STATES: Missouri, Nebraska.

Chrysops pilumna Kröber (1926)

1926. *C. pilumnus* Kröber, Stett. Ent. Ztg., LXXXVII, 278.

I have not satisfactorily identified this species. Some northwestern forms of *C. frigida* O. S. (which ultimately may prove to be a distinct species) coincide fairly well with Kröber's description except for the black on the frontoclypeus and genae, and the abdominal pattern.

Doctor Walley, of the Canadian National Museum, who kindly compared one of my specimens with Kröber's type, states as follows: "Wing pattern exactly as figured by Kröber. The maculate portion is much darker brown than in your specimen and does not fade out in the apices of marginal, first and second submarginal cells as it does in your specimen. General dorsal abdominal pattern as figured by Kröber except that first tergite is entirely dark except small posterolateral angles and there is no narrow pale posterior margin as he has shown; median black portion of second tergite slightly broader than shown by Kröber thus with narrow pale lateral areas; following tergites as in Kröber's figure. Frontoclypeus, face and genae uniformly yellow, shining, with yellowish pollinose areas as in your specimen except that the median pollinose stripe on the frontoclypeus is lacking in the type; the deep frontal fossae are brownish and the lower margins of the genae are bordered with pale brownish. Antennae (only two basal segments present) dark brownish shaded with blackish above, much as in your specimen, but a little darker throughout. There is not a well-defined line separating the large upper facets from the small lower ones, the transition is about as in your specimen; the upper facets are noticeably larger than the lower facets, the difference in size being greater than in your specimen. Leg color . . . front legs agree with your specimen; mid-coxae, trochanters, basal fourth of mid-femora and apices of mid-tarsi dull brownish black, the apical third of hind femora and entire hind tibiae uniformly yellowish-brown."

Described from one male, Jordan, Ontario. In the Canadian National Collection, type No. 2491.

Chrysops proclivis Osten Sacken (1877)

(Plate XXXI, fig. 29)

1877. *C. proclivis* Osten Sacken, West Dipt., p. 222.
1901. *C. proclivis* Ricardo, Ann. and Mag. N. H., ser. 7, VIII, 306.
1903. *C. proclivis* Hine, Can. Ent., XXXV, 244.
1904. *C. proclivis* Hine, Ohio Nat., V, 225.
1926. *C. proclivis* Cameron, Bull. Ent. Res., XVII, 24 (larva and pupa), fig.
1926. *C. proclivis* Kröber, Stett. Ent. Ztg., LXXXVII, 320.

The following also refer to this species:

1887. *C. pachycera* Williston, Trans. Kans. Acad. Sci., X, 134 (in part).
1892. *C. atricornis* Bigot, Mem. Soc. Zoöl. France, V, 604.

Color. Black and yellow, the former predominant.

Size. Length, 7.5 mm. to 9 mm.

Structural and Color Characters. Female: Vertex grayish pollinose; frons and sides of genae yellow pollinose; ocellar area, frontal callus, a connecting line between them, a spot on each side of the yellow frontoclypeus, and oral margins of the genae, fuscous to black. Palpi and antennae mostly fuscous, often with some red-brown showing through; scape, pedicel and base of flagellum sometimes yellow-brown. Dorsum of thorax and scutellum fuscous, yellow pubescent, the former with narrow gray pollinose stripes; pleurae and venter gray-yellow pollinose with the usual fuscous stripes, the former with yellow pile and on the humeri some brown. Dorsum of abdomen with a dominant black pattern; the first segment yellow with a broad black quadrate spot beneath the scutellum, posteriorly emarginate, almost attaining a heavy black median geminate figure on the second segment, on each side of which is a small black spot; segments III and IV black, narrowly incised in the center by the yellow of the hind margins, and sometimes also on each side; remaining segments black with yellow hind margins. Venter of abdomen mostly black; the segments with yellow posterolateral angles and hind margins; the second segment usually yellow with a large black median spot. Halteres fuscous. Wings as figured; the apical spot very narrow, and cell R practically entirely infuscated. Legs black and yellow, the latter distributed as follows: apex of front femora and base of tibiae, apical portion of middle and hind femora, middle and hind tibiae and metatarsi; sometimes the hind tibiae are mostly black. Male: I have no specimens at hand except that of Williston's *C. pachycera,* this sex of which has generally been conceded to be *C. proclivis.* It is quite different from the female (perhaps a teneral). The antennae, except the black apex of the flagellum, and palpi are yellow. The frontoclypeus is almost completely yellow with a trace of a brown spot on each side. The oral margins of the genae instead of being fuscous, are yellow with a small fuscous spot on each side. Thorax like the female. Dorsum of abdomen predominantly black; only the narrow posterolateral angles of the first segment, yellow; segments II and III with a very broad and heavy black double geminate figure; remaining segments black with narrow yellow hind margins; sometimes the pattern on segment V approximates that of IV, but the yellow incised areas are much more reduced. Venter of abdomen much like the female, except the yellow along the sides is more conspicuous. Wings somewhat like the female; cells R and 2d M about equally infuscated, neither completely. Legs similar to the female, with a little more yellow on the front femora and tibiae.

Comparative Notes. Separated from *C. furcata* Walker by the lateral black spots on the second abdominal tergite, but in some specimens which I believe to be *C. proclivis* these spots are obsolete. From *C. surda* O. S. this species is distinguished by the predominantly yellow frontoclypeus, its generally larger size, and a greater display of yellow on the abdomen and legs.

Type Data. Described from four females, Marin county, California. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

Canada: New Brunswick 1; Alberta 2, July 10-11; Yukon Territory 1, July 1-20.

United States: Colorado 1, July; Washington 3, June 11 - July 25; Oregon 6, June 6 - Aug. 11; California 3, June 3 - July 20.

In addition, reported by others from:

Canada: Quebec, British Columbia.

United States: Arizona.

Chrysops pudica Osten Sacken (1875)

(Plate XXXII, fig. 41)

1875. *C. pudicus* Osten Sacken, Prodrome I, 381.
1876. *C. pudicus* Osten Sacken, Prodrome II. 474.
1906. *C. pudicus* Daecke, Ent. News, XVII, 41.
1907. *C. pudicus* Daecke, Ent. News, XVIII, 145.
1907. *C. pudicus* Hine, Bull. 93, La. Exp. Sta., p. 33.
1926. *C. pudicus* Kröber, Stett. Ent. Ztg., LXXXVII, 289.

Color. Yellow, with a black abdominal pattern of variable extent and intensity.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Vertex grayish pollinose; frons and sides of genae yellow pollinose; frontal callus typically yellow, often bordered above with brown, rarely completely brown or fuscous; frontoclypeus, genae, palpi, and antennae except the black annulate portion of the flagellum, yellow to brown-yellow. Dorsum of thorax and scutellum plumbeus, the former with fuscous stripes, the latter sometimes with yellow at the tip; pleurae and venter gray pruinose with the usual fuscous stripes. Dorsum of abdomen yellow; a broader than long quadrate black spot beneath the scutellum, not attaining the hind margin of the first segment; second segment with an inverted V-shaped black spot, variable in its divergence, attaining neither margin; segments III and IV black with yellow posterior margins which expand into small mid-dorsal triangles; remaining segments black with yellow hind margins. Venter of abdomen with a quadrate black spot which becomes successively larger on segments III, IV and V; remaining segments black with yellow hind margins; black lateral streaks usually present; in specimens exhibiting much yellow, the entire venter is yellow except at the apex. Halteres fuscous. Wings as figured; the apical spot as a rule includes only the apex of cell R_4, but quite frequently it extends much deeper. Legs yellow; all trochanters, middle and hind coxae, apical portion of front tibiae and entire tarsi, apical segments of middle and hind tarsi, basal portion of hind femora, apex of hind tibiae, fuscous; sometimes the hind femora and tibiae are mostly yellow. Male: At the University of Michigan are a series of males from Florida determined by Hine, which I believe to be this species. They are very similar to the females.

Comparative Notes. Separated from *C. cursim* Whit. as indicated in the key. Also see under description of *C. cursim.* Some forms of *C. pudica* (especially those with the fuscous frontal callus and the apical spot including more than the apex of cell R_4) may be confused with *C. dimmocki* Hine, but in that species the black V-shaped spot on the second abdominal tergite invariably attains the anterior margin.

Remarks. It will be seen from the description that this is a variable species and hence considerable caution must be exercised in separating it from related forms.

Type Data. Described from three females from Massachusetts and one female, locality not certain. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: Massachusetts 2, June 16; Rhode Island 1, July; New York 2, June 23 - July 17; New Jersey 8, June 24 - Aug. 15; North Carolina 4, May 25 - July 17; Georgia 2, May 14 - June; Florida 2, April 8 - May 12.

In addition, reported by others from:

UNITED STATES: Connecticut, Louisiana.

Chrysops robusta, new species

(Plate XXXIV, fig. 67; Plate XXXV, fig. 87; Plate XXXVII, figs. 106, 113)

Color. Fulvous, with a fuscous abdominal pattern.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Vertex broader than long, yellow pollinose; frons, sides of genae and a mid-streak on the frontoclypeus yellow pollinose; the region immediately surrounding the antennae white pollinose; frontal callus yellow, bordered with brown; frontoclypeus, oral margin of genae and palpi, yellow. Antennae strongly incrassate; scape and pedicel brown-yellow with rather coarse black pubescence; flagellum black except for a little yellow at its base. Dorsum of thorax and scutellum fuscous with a brownish pruinosity and long whitish pile, the former with broad fulvous pollinose stripes; pleurae and venter fulvous pollinose with whitish pile, the usual brown stripes somewhat faint. Dorsum of abdomen fulvous with a fuscous quadrate spot, posteriorly emarginate, beneath the scutellum; anterolaterally this spot relatively connects with an obscure fuscous spot on each side; second segment with a double geminate fuscous spot, the outer portions of which are narrowly lunate; segments III, IV and V each with a double geminate fuscous spot; remaining segments fuscous; all segments with narrow fulvous posterior margins. Venter of abdomen fulvous, the first three segments each with a broad fuscous quadrate median spot; the remaining segments fuscous with yellow hind margins; the usual lateral stripes present. Halteres yellow. Wings as figured. Legs yellow; the joints, apical portion of front tibiae and entire tarsi apices of middle and hind tarsal segments, black. Male: Head and its appendages like the female except for sex characters. Thorax like the female, but somewhat darker; the humeral region of the pleurae black pilose. Dorsum of abdomen predominantly black; the first segment entirely so except for a little yellow at the posterolateral angles; segments II, III and IV each with a double geminate black figure whose outer portions, especially on the second segment, are narrow; remaining segments black with yellow hind margins; sometimes segment V bears a black figure suggestive of that on the preceding segment. Venter yellow with a broad black mid-stripe and on each side a narrow lateral one; apical segments mostly black with yellow hind margins. Halteres yellow. Wings like the female except for a greater extent of infuscation in cells R and 2d M; base of cell 1st A infuscated. Legs like the female.

Comparative Notes. This species is related to *C. coquilletti* Hine and *C. clavicornis* n. sp. From the former it may be separated by the abdominal pattern (especially the figure on the second tergite) and by the greater extent of infuscation in cell 2d M of the wings; from the latter by the abdominal pattern, the apical spot of the wings not exceeding cell R_4, and by the scape of the antenna which is uniformly swollen for its entire length.

Type Data. Holotype, female; Los Angeles, California; May 2, 1915; M. C. VanDuzee. Allotype, male; same data. Paratype, one male, Los Cerritos, California; March 21, 1915; M. C. VanDuzee. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

Chrysops sackeni Hine (1903)

(Plate XXXI, fig. 32)

1903. *C. sackeni* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, 42.
1907. *C. sackeni* Daecke, Ent. News, XVIII, 145.
1926. *C. sackeni* Kröber, Stett. Ent. Ztg., LXXXVII, 287.
1931. *C. sackeni* Philip, Minn. Tech. Bull., LXXX, 95.

Color. Black and yellow, the former dominant in the abdominal pattern.

Size. Length, 7.5 mm. to 10.5 mm.

Structural and Color Characters. Female: Vertex, frons, and sides of genae, gray-yellow pollinose; frontal callus variable, yellow margined above with black, black with yellow on the disc, or wholly black; frontoclypeus, genae, and palpi, orange-yellow; antennae orange-yellow except the black apex of the flagellum. Dorsum of thorax and scutellum fuscous, the former with broad, gray pollinose stripes; pleurae and venter gray-yellow pollinose with fuscous stripes. Abdominal dorsum yellow with a dominant black pattern; a broad black quadrate spot beneath the scutellum, posteriorly emarginate, nearly reaching a heavy inverted V-shaped spot on the second segment which often follows along the posterior margin; remaining segments black with yellow posterior margins which on segments III and IV expand into middorsal triangles and narrow lateral spots. Venter of abdomen yellow with a median black spot on each segment from I to IV, becoming successively larger caudad; remaining segments black with yellow hind margins; the usual black lateral streaks; sometimes the basal three or four segments are wholly yellow. Halteres black. Wings as figured; the apical spot at its base just exceeding vein R_{2+3}; the crossband not attaining the posterior margin. Legs orange-yellow; the joints, apex of front tibiae and entire tarsi, basal portion of hind femora, apical segments of middle and hind tarsi, black; sometimes the entire hind femora and apex of tibiae are black. Male: Head and thorax like the female except for sex characters. On the dorsum of the abdomen the black figures on segments I and II are much broader; the yellow hind margins of the remaining segments are narrower and consequently the middorsal triangles on III and IV are smaller. In one specimen the sides of III and IV are more broadly yellow than in the female. Venter of abdomen like the female. Wings with more infuscation in cells R and 2d M; otherwise like the female. Legs darker than in the female; the front femora and sometimes the apex of the front coxae, base of middle femora, black.

Comparative Notes. Separated from *C. callida* O. S. by the broader apical spot and generally larger size; likewise I have never seen a specimen of *C. callida* with any yellow on the frontal callus.

Type Data. In the Ohio State Museum, Columbus, Ohio. Four females, Sandusky, Ohio, June 29, 1899, and July 10, 1900.

Distributional Data:

UNITED STATES: Massachusetts 2, June 28; New York 3, June 27 - July 4; New Jersey 1, June 17-25; North Carolina 1, May 8; Florida 1, April 16; Michigan 5, July 3 - July 18; Ohio 2, June 8 - July 5; Indiana 1, July 1; Tennessee 1; Illinois 3, June 15 - Aug. 24; Minnesota 1, July 12; Iowa 1, June 21; Utah.

In addition, reported by others from:

CANADA: Quebec.

UNITED STATES: Vermont, Rhode Island, Connecticut, Wisconsin.

Chrysops separata Hine (1907)

(Plate XXXIII, fig. 58)

1907. *C. separatus* Hine, Ohio Nat., VIII, 228.
1926. *C. separatus* Kröber, Stett. Ent. Ztg., LXXXVII, 311.

Color. Black.

Size. Length, 8 mm.

Structural and Color Characters. Female: Vertex, frons, sides of genae, a streak on the frontoclypeus, gray to gray-yellow pollinose; ocellar area, frontal callus, frontoclypeus, oral margin of genae, and palpi, black. Antennae mostly black, basal portions of scape, pedicel, and flagellum, yellow to brown-yellow. Thoracic dorsum and scutellum black with whitish pubescence, the former with traces of gray pollinose stripes; pleurae and venter black with some gray pruinosity, abdomen black, white pubescent. Halteres black. Wings as figured, the apical spot separated from the crossband. Legs black, extreme base of anterior tibiae, basal portion of median tibiae, median and posterior metatarsi, yellowish. Male: Like the female with much black pubescence and pilosity intermixed with a little white. Antennae almost entirely black. Wings to the distal border of the crossband almost entirely infuscated, more dilute in cells Cu_1, 1st A, and the anal angle; a small hyaline spot includes the extreme apex of cells R, 2d M and the base of cell Cu_1; apical spot like the female. Legs like the female except for the absence of yellow at the bases of the front and middle tibiae.

Comparative Notes. *C. separata* is distinct from all others included within this paper. The black color and the apical spot entirely separated from the crossband will easily identify this species.

Remarks. Kröber (1926) has misquoted Hine's description. Only the first basal cell (R) is black, not both basal cells (R and 2d M). To my knowledge this is the first time the male has been described. Brimley (1922) lists a male taken at Raleigh, North Carolina, April 20, 1921, but gives no further data.

Type Data. Holotype, female; Raleigh, North Carolina; April 18, 1906; C. S. Brimley. In the Ohio State Museum, Columbus, Ohio.

Distributional Data:

UNITED STATES: North Carolina: Raleigh. Mississippi: Agricultural College, March 19, 1921 (♂). Oklahoma: Atoka Co., May 22, 1933, May 26, 1934.

In addition, reported by others from:

UNITED STATES: Louisiana.

Chrysops sequax Williston (1887)

(Plate XXXII, fig. 48)

1887. *C. sequax* Williston, Trans. Kans. Acad. Sci., X, 133.
1904. *C. sequax* Hine, Ohio Nat., V, 225.
1906. *C. sequax* Daecke, Ent. News, XVII, 41.
1907. *C. sequax* Daecke, Ent. News, XVIII, 141.
1907. *C. sequax* Hine, Bull. 93, La. Exp. Sta., p. 34.
1918. *C. sequax* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 198.
1924. *C. sequax* Wehr, Neb. Univ. Studies, XXII, 113.
1926. *C. sequax* Kröber, Stett. Ent. Ztg., LXXXVII, 345.
1930. *C. sequax* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., 14.
1931. *C. sequax* Philip, Minn. Tech. Bull., LXXX, 92.

Color. Black and yellow with vittate abdominal pattern.

Size. Length, 8 mm. to 9 mm.

Structural and Color Characters. Female: Vertex grayish yellow pollinose; sides of genae yellow pollinose; frontal callus black, but not infrequently with some yellow; frontoclypeus, except a black spot on each side, palpi and antennae, except the black apex of the flagellum, yellow; oral margins of genae black. Dorsum of thorax and scutellum green-gray pollinose, the former with fuscous stripes, sometimes the latter yellow at the tip; pleurae and venter yellow pollinose with the usual fuscous stripes. Dorsum of abdomen yellow with four complete black longitudinal stripes; the apical segments black with yellow hind margins. Venter of abdomen yellow; usually a black quadrate spot on each of segments III to V; remaining segments black with yellow hind margins; the usual lateral streaks present. Halteres fuscous. Wings as figured; the apex of the hyaline triangle attains vein R_{2+3}, and its base is of variable width. Legs yellow; apex of front tibiae and entire tarsi; basal portions of middle and hind femora, apex of hind tibiae, apical segments of middle and hind tarsi, black. Male: Like the female except for sex characters and more pronounced melanism. The palpi are darker. The black abdominal stripes are broader; the median spots on the venter are coalesced, thus forming a broad stripe which tapers toward the base. Cell 2d M of the wings infuscated for about one half its length, the brown color tapering along vein Cu to the end of the cell; cell Cu_1 infuscated except for a hyaline spot at its apex; cell 1st A infuscated along its upper margin, the brown color following vein Cu and Cu_2 to the posterior margin of the wing; anal area dilutely infuscated. Legs like the female except the posterior femora and tibiae which are yellow only at their apex and base respectively.

Comparative Notes. A more variable species than its close relative *C. pikei* Whit. from which it is at once separated by the complete lateral abdominal stripes. From *C. beameri* n. sp. *C. sequax* may be distinguished by its frontal callus which is usually black, and the apex of the hyaline triangle of the wing not exceeding vein R_{2+3}. See under description of *C. beameri.*

Type Data. Described from four females and one male from Western Kansas. One female and the male remain in the Francis Huntington Snow Entomological Collection of the University of Kansas.

Distributional Data:

UNITED STATES: Massachusetts 1, Aug. 6; New Jersey 4, July 16 - Sept. 8; Virginia 2, Aug. 28 - Sept. 9; North Carolina 3, July 25 - Sept. 5; South Carolina 1, Aug. 18; Georgia 2, July 27; Ohio 1, July 24; Indiana 1, July 27; Illinois 6, July 10 - Sept. 1; Minnesota 1, Aug. 5; Iowa 1; South Dakota 1; Kansas 15, July 5 - Aug. 26; Oklahoma 1, Aug. 19; Colorado 1, Aug. 17-19.

In addition, reported by others from:

UNITED STATES: Maryland, Arkansas, Louisiana, Nebraska.

Chrysops shermani Hine (1907)

(Plate XXXII, fig. 38)

1907. *C. shermani* Hine, Ohio Nat., VIII, 229.
1926. *C. shermani* Kröber, Stett. Ent. Ztg., LXXXVII, 347.

Color. Black and yellow; abdominal pattern more or less vittate; the dilute crossband of the wings interrupted with hyaline where it crosses the veins.

Size. Length, 8 mm. to 10 mm.

Structural and Color Characters. Female: Vertex, frons and sides of genae yellow pollinose; frontal callus orange-yellow, bordered above with brown which continues as a line to the fuscous ocellar area; frontoclypeus, oral margins of genae, and palpi orange-yellow. Antennae slender; scape yellow, reddish near the apex; pedicel and base of black flagellum red-brown. Dorsum of thorax and scutellum black, the former with gray-yellow pollinose stripes; pleurae and venter yellow pollinose with the usual fuscous stripes. Dorsum of abdomen yellow; a large quadrate black spot beneath the scutellum practically coalescing with a parallel-sided black geminate spot on the second segment, on each side of which is a narrow black vittate spot not attaining the anterior margin; segments III to V each with four black vittate spots which do not attain the posterior margins; remaining segments black with yellow hind margins; the spots on segment V are usually so close so that it has the aspect of the apical segments. Venter yellow; a small fuscous median spot on each of segments III to V; remaining segments black with yellow hind margins; the usual black lateral streaks, not quite attaining the base. Halteres fuscous. Wings as figured; the crossband dilute, interrupted with hyaline where it crosses the veins, not reaching the posterior margin; stigma saturate brown; apical spot nearly separated from the crossband, dilute, also interrupted by hyaline along the veins. Legs yellow; the joints, apical portion of front tibiae and entire tarsi, base of hind femora and apex of tibiae, apical four middle and hind tarsal segments, black. Male: This sex has never been reported.

Comparative Notes. *C. shermani* is distinct from all other North American species by virtue of its unique wing pattern. The abdominal pattern is somewhat like that of *C. montana* O. S.

Type Data. Cotypes, five females from Highlands, North Carolina, July, 1907, one female, same locality, July 5, 1906; one female, Hayden, Ontario, July 10, 1906. In the Ohio State Museum, Columbus, Ohio. One cotype female in the Museum of Comparative Zoölogy, Cambridge, Massachusetts (C. W. Johnson Collection).

Distributional Data:

CANADA: Ontario: Hayden, July 30, 1906; Algonquin Park, July 28-31, 1916; Brule Lake, Aug. 2, 1911.

UNITED STATES: North Carolina: Highlands, July 5, 1906, July, 1907. Michigan: Cheboygan Co., July 11, 1931; Marquette Co., July 15, 1919; Dickinson Co., July 16, 1909.

Chrysops sordida Osten Sacken (1875)

(Plate XXX, fig. 15)

1875. *C. sordidus* Osten Sacken, Prodrome I, 376.
1926. *C. sordidus* Kröber, Stett. Ent. Ztg., LXXXVII, 249.

Color. Black, abdominal tergites with gray hind margins, the first two encroached upon on each side by a small gray-yellow spot.

Size. Length, 8 mm. to 10 mm.

Structural and Color Characters. Female: Vertex gray pollinose; frons, a mid-streak on the frontoclypeus, and sides of genae yellowish pollinose; frontal callus, frontoclypeus, oral margins of genae, and palpi, fuscous to black. Antennae fuscous; the scape except its extreme apex, yellow. Dorsum of thorax and scutellum black with yellowish pubescence, the former with faint gray pollinose stripes; pleurae and venter fuscous with a gray pruinosity, the former with yellow pile. Dorsum of abdomen black; a small gray-yellow spot on each side near the base; all segments caudad from II with rather conspicuous gray hind margins which on segments II to IV expand into median triangles. Venter black; the segments with narrow pale hind margins. Halteres fuscous. Wings as figured; often a narrow trace of an apical spot present. Legs black; the middle and hind metatarsi dark brown. Male: Unknown.

Comparative Notes. Separated from *C. excitans* Walker by the gray hind margins of the abdominal tergites and the smaller extent of the pale spot on each side of tergites I and II. From *C. cuclux* Whit. *C. sordida* is readily distinguished by the more saturate wing picture and again by the gray hind margins of the abdominal tergites.

Type Data. Described from nine females from the White Mountains, New Hampshire. I have studied the types, in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

CANADA: Newfoundland: Little River, July 15, 1905.

UNITED STATES: New Hampshire: White Mountains. New York: Cranberry Lake, June 9-20, 1919; Essex Co., July 22, 1920.

In addition, reported by others from:

CANADA: Labrador.

UNITED STATES: Maine.

Chrysops striata Osten Sacken (1875)

(Plate XXXII, fig. 39)

1875. *C. striatus* Osten Sacken, Prodrome I, 391.
1903. *C. striatus* Hine, Ohio St. Acad. Spec. Pap. No. 5, 43.
1906. *C. striatus* Daecke, Ent. News, XVII, 41.
1907. *C. striatus* Daecke, Ent. News, XVIII, 141.
1918. *C. striatus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 198.
1925. *C. striatus* Hine, Occ. Pap. Mus. Zoöl. Univ. Mich., No. 162, 20.
1925. *C. striatus* Kröber, Konowia, IV, 331.
1926. *C. striatus* Kröber, Stett. Ent. Ztg., LXXXVII, 343.
1930. *C. striatus* Stone, Ann. Ent. Soc. Am., XXIII, 287.
1931. *C. striatus* Philip, Minn. Tech. Bull., LXXX, 92.

Color. Black and yellow; abdominal pattern vittate.

Size. Length, 7 mm. to 9.5 mm.

Structural and Color Characters. Female: Vertex, frons, and sides of genae, yellow pollinose; frontal callus variable, black to yellow; frontoclypeus, oral margins of genae, and palpi, yellow; sometimes the frontoclypeus with a small black spot on each side. Antennae slender, variable in color; sometimes yellow with only the apex of the flagellum black; or sometimes the scape and pedicel red-brown, especially on their outer surfaces. Dorsum of thorax and scutellum plumbeus in ground color, the former with the usual fuscous stripes, the latter often yellow at the tip; pleurae gray-yellow pollinose with fuscous stripes. Dorsum of abdomen yellow; typically with four black longitudinal stripes, the median pair broader, the lateral ones not always reaching the base; these stripes are often broken by the yellow margins of the segments; the two apical segments black with yellow hind margins; in some specimens the median stripes so converge on the second segment that they form a sort of geminate figure. Venter of abdomen variable; usually yellow at the base; the black of the apical segments extending toward the base as a broad midstripe; lateral streaks present. Halteres fuscous. Wings as figured. Legs yellow; trochanters, apical portion of front tibiae and entire tarsi, bases of middle and hind femora, apex of hind tibiae, apical segments of middle and hind tarsi, black. Male: Like the female but that cell 2d M of the wings is infuscated except for a small hyaline area near the apex, cubital and anal regions dilutely infuscated. The median stripes of the abdominal dorsum are broader than in the female, usually coming together near the anterior margin of the second segment. The median stripe of the abdominal venter practically attains the base.

Comparative Notes. The species is so variable that separation is often difficult. Its closest relative is *C. vittata* Wied., from which it is most readily distinguished by the plumbeus ground color of the thoracic dorsum and scutellum. Philip (1931) states that the thoracic stripes may vary from greenish-gray to a yellow not much different from that of *C. vittata.*

Remarks. Philip (1931) has given an excellent account of the variability of *C. striata.* His material consisted of over two hundred and fifty specimens.

Type Data. Described from several females from the District of Columbia and Illinois. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: Massachusetts 2, July 3 - Aug. 9; New York 4, July 1-26; New Jersey 1, July 3; Pennsylvania 1, June 26; Michigan 4, July 10 - Sept. 7; Ohio 8, June 10 - Aug. 14; Indiana 1, July 10 - Aug. 23; Wisconsin 2, June 24 - July 10; Illinois 3, July 5-15; Minnesota 5, July 20 - Aug. 7.

In addition, reported by others from:

CANADA: Quebec, Ontario.

UNITED STATES: Maine, New Hampshire, Maryland, District of Columbia, Virginia, Louisiana.

Chrysops surda Osten Sacken (1877)

(Plate XXXI, fig. 27)

1877. *C. surdus* Osten Sacken, West. Dipt., p. 223.
1887. *C. surdus* Williston, Trans. Kans. Acad. Sci., X, 134.
1904. *C. surdus* Hine, Ohio Nat., V, 226.
1926. *C. surdus* Kröber, Stett. Ent. Ztg., LXXXVII, 322.

Color. Predominantly black; abdominal pattern with some yellow.

Size. Length, 6.5 mm.

Structural and Color Characters. Female: Vertex gray pollinose; frons and sides of genae yellow pollinose; ocellar area, frontal callus, a line connecting them, frontoclypeus (except a denuded brown-yellow mid-streak), oral margins of genae, and palpi, fuscous to black. Antennae fuscous; basal segments brown-yellow, red-brown, or sometimes fuscous, especially on the outer surfaces. Thoracic dorsum and scutellum black, the former with gray pollinose stripes; pleurae and venter gray pollinose with the usual black stripes. Dorsum of abdomen predominantly black; first segment yellow with a large quadrate black spot beneath the scutellum practically attaining a heavy black median geminate figure on the second segment, on each side of which is a small black spot; sometimes an anterolateral black spot is apparent on the first segment;

segments III and IV black, narrowly incised in the center by the yellow of the hind margins; remaining segments black with yellow hind margins. Venter black; the segments with yellow hind margins; first three or four segments yellow, each with a large black median spot becoming successively broader caudad; broad black lateral stripes present, practically attaining the base. Wings as figured. Halteres black. Legs black; extreme base of front tibiae, apex of middle femora, basal portion or all of middle tibiae, middle and hind metatarsi, brown-yellow. Male: Like the female except for sex characters; exhibiting more melanism. Cell 2d M of the wings considerably infuscated. The black of the first two abdominal tergites more extensive than in the female.

Comparative Notes. Separated from *C. proclivis* O. S. by the black frontoclypeus with only a narrow yellow mid-streak, the dominantly black legs, and generally smaller size.

Type Data. Described from four females, Webber Lake, Sierra county, California, July 21. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: Oregon: Mt. Hood. California: Giant Forest, July 28, 1929; Tahoe, June 19, 1927; Plumas Co., July 20-22, 1916; Fallen Leaf, July 16, 1917; Shasta Co. Nevada: Ormsby Co., July 6.

In addition, reported by others from:

CANADA: British Columbia.
UNITED STATES: Washington.

Chrysops ultima Whitney (1914)

(Plate XXXIII, fig. 53)

1914. *C. ultimus* Whitney, Can. Ent., XLVI, 345.
1926. *C. ultimus* Kröber, Stett. Ent. Ztg., LXXXVII, 320.

Color. Fuscous.

Size. Length, 8 mm.

Structural and Color Characters. Female: Vertex, frons and sides of genae, gray to gray-yellow pollinose; ocellar area, frontal callus, a line connecting them, a spot on each side of the yellow frontoclypeus, oral margins of genae, and palpi, fuscous. Antennae slender; scape yellow, pedicel and base of flagellum brown-yellow, apex of flagellum, black. Dorsum of thorax and scutellum fuscous, the former with faint gray pollinose stripes, most pronounced anteriorly; pleurae and venter gray pollinose with the usual fuscous stripes. Abdomen fuscous, a very faint grayish middorsal stripe sometimes apparent. Halteres fuscous. Wings as figured; the hyaline triangle narrow and open to R_{2+3}. Legs yellow; the joints, apical portion of front tibiae and entire tarsi, bases of middle and hind femora, apex of hind tibiae, apical segments of middle and hind tarsi, fuscous. Male: Unknown.

Comparative Notes. To be separated from its very close relatives according to the key. Wing picture like *C. obsoleta* Wied.; abdomen more like *C. parvula* Daecke and *C. lugens* Wied.

Remarks. I have seen but a few specimens of this species. I doubt its validity, but I have not sufficient evidence to support my belief.

Type Data. Described from West Palm Beach, Florida. One female (the head missing) in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: New York 1, Aug. 20-30; New Jersey 3, July 29 - Aug. 28; Maryland 1, June 26; North Carolina 1, May 16; Florida 4, March - April 6.

Chrysops univittata Macquart (1855)

(Plate XXXIII, fig. 56)

1855. *C. univittatus* Macquart, Dipt. Exot., Suppl., V, 36.
1875. *C. univittatus* Osten Sacken, Prodrome I, 387.
1903. *C. univittatus* Hine, Ohio St. Acad. Spec. Pap. No. 5, 44.
1906. *C. univittatus* Daecke, Ent. News, XVII, 41.
1907. *C. univittatus* Daecke, Ent. News, XVIII, 141.
1907. *C. univittatus* Hine, Bull. 93, La. Exp. Sta., p. 34.
1918. *C. univittatus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 198.
1926. *C. univittatus* Kröber, Stett. Ent. Ztg., LXXXVII, 335.
1931. *C. univittatus* Philip, Minn. Tech. Bull., LXXX, 93.

Color. Black and yellow; abdominal pattern vittate, with a broad yellow median stripe.

Size. Length, 6 mm. to 8.5 mm.

Structural and Color Characters. Female: Vertex gray-yellow pollinose; frons and sides of genae yellow pollinose; frontal callus and a spot on each side of the frontoclypeus, fuscous; frontoclypeus, oral margins of genae, and palpi, yellow. Scape of antenna yellow; pedicel and base of flagellum brown-yellow; remainder of flagellum black. Thoracic dorsum gray pollinose with narrow fuscous stripes; scutellum fuscous, sometimes yellow except on the disc; pleurae and venter gray-yellow pollinose with the usual fuscous stripes. Dorsum of abdomen with a conspicuous yellow median stripe enclosed between two fuscous stripes whose outer sides are irregular in outline; lateral margins yellow; apical two segments usually entirely fuscous. Venter of abdomen yellow; the black of the apical segments extends toward the base as a broad median stripe; black lateral streaks present. Wings as figured; the apical spot very broad. Legs yellow; the trochanters, apical portion of front tibiae and entire tarsi, apical segments of middle and posterior tarsi, black; sometimes the base of the hind femora, black. Male: Very similar to the female; the infuscation of cell 2d M more extensive; the black of the median abdominal stripes more nearly reaching the lateral margins.

Comparative Notes. Separated from *C. moecha* O. S. by the greater extent of the hyaline triangle of the wing and by the two fuscous abdominal stripes instead of four. See, also, under description of *C. moecha*.

Type Data. Described from female specimens from Baltimore, Maryland. In the Museum of Lille.

Distributional Data:

UNITED STATES: Maine 1, July 6-9; New Hampshire 2, July 16; Massachusetts 4, June 25 - July 16; Connecticut 2, June 22 - July 2; New York 5, June 23 - Aug. 23; New Jersey 6, June 21 - July 4; Delaware 1, June 29; Maryland 12, June 6 - Aug. 8; District of Columbia 1, June 14; Virginia 8, May 31 - Sept. 1; North Carolina 1, Aug. 13; Georgia; Pennsylvania 6, June 5 - July 20; Michigan 3; Ohio 20, June 2 - Aug. 27; Indiana 1, July 12; Illinois 3, July 10-17; Kansas.

In addition, reported by others from:

CANADA: Quebec.

UNITED STATES: Florida, Wisconsin, Minnesota, Louisiana.

Chrysops virgulata Bellardi (1861)

(Plate XXXIV, fig. 71; Plate XXXV, fig. 88)

1861. *C. virgulatus* Bellardi, Saggio I, 71, pl. II, f. 17.
1901. *C. virgulatus* Williston, Biologia, Dipt. 1, 255.
1904. *C. virgulatus* Hine, Ohio Nat., V, 226.
1925. *C. virgulatus* Kröber, Konowia, IV, 235.
1926. *C. virgulatus* Kröber, Stett. Ent. Ztg., LXXXVII, 256.

The following also refer to this species:

1850. *C. geminatus* Macquart (nec Wied.), Dipt. Exot., Suppl. IV, 39.
1884. *C. crassicornis* Van der Wulp, Wien., Ent. Ztg., III, 141.

Color. Fulvous with black abdominal pattern.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Vertex broader than long, gray-yellow pollinose; frons, sides of genae, and a mid-streak on the frontoclypeus, yellowish pollinose; upper margin of frontal callus and a small spot on each side of the oral margins of the genae, fuscous; frontal callus, remainder of genae and palpi, yellow. Antennae strongly incrassate, the annulate portion of the flagellum shorter than the basal segment; wholly yellow or brown-yellow except the black apex of the flagellum. Dorsum of thorax and scutellum fulvous pollinose, the former with faint brown stripes; pleurae and venter fulvous pollinose with the usual brown regions. Abdominal dorsum fulvous; a quadrate black spot beneath the scutellum, posteriorly emarginate, sometimes expanding anterolaterally; segments II to IV each with a heavy double geminate black figure the outer portions of which are narrowly lunate; remaining segments mostly black with yellow hind margins; sometimes the pattern on the fifth segment corresponds to those preceding. Venter of abdomen fulvous; the black of the apical segments produced basally as a median stripe; the black lateral stripes attain the base. Halteres yellow. Wings as figured. Legs yellow; the joints, apical portion of front tibiae and entire tarsi, apical segments of middle and hind tarsi, black. Male: Easily associated with the female, but much darker. The palpi and antennae are yellow-brown. Dorsum of thorax and scutellum with fuscous ground color. Abdomen like the female, except the black is more extensive, the first tergite being entirely black except for the narrow posterolateral angles. Wings like the female except that the infuscation of cell 2d M is equal to that of cell R and cell 1st A is more extensively infuscated. Legs generally darker.

Comparative Notes. Easily distinguished from related species with the broad vertex and swollen antennae by the very short annulate portion of the flagellum. The abdominal pattern is much like that of *C. robusta* n. sp.

Remarks. This is the first time that *C. virgulata* has been reported north of Mexico.

Type Data. Described from a male specimen, Cuautla, Mexico; from Saussure's Collection. Probably in the Museum of Turin.

Distributional Data:

United States: Texas: Kingsville, June 8, 1921; Del Rio, May 27, 1912. Arizona: Douglas, Aug.; San Bernardino Ranch.

Mexico: Jalisco: Quadalajara, June 18, 1903, July 21, 1903, Aug. 8, 1903.

In addition, reported by others from:

Mexico: Guerrero: Guanajuata, Colima.

Chrysops vittata Wiedemann (1821)

(Plate XXXII, fig. 42; Plate XXXV, fig. 82)

1821. *C. vittatus* Wiedemann, Dipt. Exot., 106.
1828. *C. vittatus* Wiedemann, Auss. Zw., I, 200.
1855. *C. vittatus* Macquart, Dipt. Exot., Suppl. V, 37.
1875. *C. vittatus* Osten Sacken, Prodrome I, 390.
1895. *C. vittatus* Townsend, Trans. Amer. Ent. Soc., XXII, 57.
1895. *C. vittatus* Hart, Bull. Ill. State Lab. N. H., IV, 228. (Larva and pupa.)
1902. *C. vittatus* Howard, Ins. Book, pl. XV, f. 37.
1903. *C. vittatus* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, 44.
1906. *C. vittatus* Daecke, Ent. News, XVII, 41.
1907. *C. vittatus* Daecke, Ent. News, XVIII, 141.
1907. *C. vittatus* Hine, Bull. 93, La. Exp. Sta., p. 35.
1918. *C. vittatus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 198.
1920. *C. vittatus* Marchand, Mon. Rock. Inst., No. 13, p. 52.
1924. *C. vittatus* Wehr, Neb. Univ. Studies, XXII, 113.
1926. *C. vittatus* Kröber, Stett. Ent. Ztg., LXXXVII, 339.
1930. *C. vittatus* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., f. 2.
1930. *C. vittatus* Stone, Ann. Ent. Soc. Am., XXIII, 288.
1931. *C. vittatus* Schwardt, Jl. Kans. Ent. Soc., IV, 9.
1931. *C. vittatus* Philip, Minn. Tech. Bull., LXXX, 94.

The following also refer to this species:

1848. *C. areolatus* Walker, List I, 197.
1867. *C. lineatus* Jeannicke, Neue Exot Dipt., p. 26.

Color. Yellow; dorsum of abdomen with four black stripes.

Size. Length, 6.5 mm. to 10 mm.

Structural and Color Characters. Female: Vertex, frons, and sides of genae yellow pollinose; frontal callus, frontoclypeus, genae, and palpi, yellow. Antennae slender, yellow, except the black apical portion of the flagellum. Dorsum of thorax and scutellum yellow, the former with fuscous stripes; pleurae and venter yellow with the usual fuscous stripes. Dorsum of abdomen yellow with four black longitudinal stripes; the median pair usually, but not always, complete, the lateral ones usually incomplete. Venter of abdomen yellow; the black of the apical segments may or may not extend part way to the base as a median stripe; the usual lateral streaks present. Halteres fuscous. Wings as figured; the fuscous streak extending from the distal margin of the crossband into cell R_5 not always present. Legs yellow; apex of front tibiae and entire tarsi, middle and hind coxae and trochanters, apical three or four segments of the middle and hind tarsi, fuscous. Male: Similar to the female except for sex characters and a greater extent of infuscation in cell 2d M of the wing. The sexes are very readily associated.

Comparative Notes. Exhibits more yellow than its closest relative *C. striata* O. S. The yellow frontal callus, yellow ground color of the thorax, wholly yellow scutellum, and predominantly yellow legs offer the best characteristics for separation. See, also, under description of *C. striata.*

Type Data. In the Museum of Vienna. Kröber (1926) states that no specimen is designated as the type.

Distributional Data:

CANADA: Quebec 1, July 1.

UNITED STATES: Maine 3, June 9 - Aug. 10; New Hampshire 3, July 4-16; Massachusetts 5, July 16 - July 24; Rhode Island 1, July 28; Connecticut 3, June 24 - July 25; New York 8, June - Aug. 14; New Jersey 4, June 28 - Aug. 15; Delaware 2, June 29 - Aug. 3; Maryland 14, June 23 - Sept. 23; District of Columbia 2, Aug. 7-19; Virginia 10, June 12 - Aug. 29; North Carolina; South Carolina 1, Aug. 24; Georgia 3, July 10 - Aug. 22; Florida 2, June 1 - Aug. 17; Pennsylvania 7, June 4 - Aug. 22; Michigan 4, June 1 - Aug.; Ohio 16, June 11 - Aug. 28; Indiana 1, July 1 - Aug. 7; Alabama 2, July 21-22; Wisconsin; Illinois 3, July 8-26; Mississippi 4, July 14-17; Minnesota; Iowa 1; Missouri 1; Arkansas 1, June 29; Louisiana 2, June 9-29; Kansas 2, July 9 - Sept. 4.

In addition, reported by others from:

CANADA: Ontario.

United States: Nebraska.

Chrysops vittata floridana Johnson (1913)

(Plate. XXXII, fig. 43)

1913. *C. vittatus floridanus* Johnson, Bull. Am. Mus. N. H., XXXII, 52.
1926. *C. vittatus floridanus* Kröber, Stett. Ent. Ztg., LXXXVII, 341.

Color. Yellow; abdominal stripes obscure.

Size. Length, 9 mm.

Structural and Color Characters. Female: General aspect of *C. vittata* Wied. The thoracic stripes are light brown, the abdominal stripes more obsolete. Wings as figured; the infuscation more extensive than in *C. vittata,* especially the apical spot. Legs like *C. vittata.* Male: This sex has not been reported.

Type Data. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts. I have studied the types.

Distributional Data:

UNITED STATES: Virginia: Hickory, July 3, 1903. Georgia. Florida: Alachua Co., May 31, 1925, Sept. 15, 1923; Hillsboro Co., March 23, 1925; Horse Landing, May 17, 1894; St. John's River, May 7-17, 1924; Paseo Co., April 22, 1930; Putnam Co.

Chrysops wiedemanni Kröber (1926)

(Plate XXXIII, fig. 52)

1926. *C. wiedemanni* Kröber, Stett. Ent. Ztg. LXXXVII, 267 (new name for *C. obsoletus* of authors, nec Wied.).
1930. *C. wiedemanni* Stone, Ann. Ent. Soc. Am., XXIII, 290.
1931. *C. wiedemanni* Philip, Minn. Tech. Bull., LXXX, 94.

The following also refers to this species:

1875. *C. obsoletus* Osten Sacken, Prodrome 1, 393.
1903. *C. obsoletus* Hine, Ohio St. Acad. Spec. Pap. No. 5, 42.
1906. *C. obsoletus* Daecke, Ent. News, XVII, 38.
1907. *C. obsoletus* Daecke, Ent. News, XVIII, 144.
1907. *C. obsoletus* Hine, Bull. 93, La. Exp. Sta., p. 32.
1918. *C. obsoletus* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 197.
1924. *C. obsoletus* Wehr, Neb. Univ. Studies, XXII, 112.
1930. *C. obsoletus* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., p. 13.
1931. *C. obsoletus* Schwardt, Jl. Kans. Ent. Soc., IV, 8.
1926. *C. fraternus* Kröber, Stett. Ent. Ztg., LXXXVII.

Color. Fuscous; dorsum of abdomen typically with a yellow median stripe.

Size. Length, 6.5 mm. to 8 mm.

Structural and Color Characters. Female: Vertex gray pollinose; frons and sides of genae yellowish pollinose; frontal callus, a spot on each side of the frontoclypeus, another on the oral margins of the genae, and palpi, fuscous to black; remainder of frontoclypeus and genae, yellow. Scape of antenna yellow; pedicel and base of flagellum brown-yellow; apical portion of flagellum black. Dorsum of thorax and scutellum plumbeus, the former with fuscous stripes, sometimes the latter yellow at the tip; pleurae and venter yellow pollinose with the usual fuscous stripes. Dorsum of abdomen fuscous with a conspicuous yellow median stripe; in one specimen also a yellow lateral stripe on each side. Venter variable; usually yellow with a broad fuscous median stripe extending basally from the fuscous apical segments, and the usual lateral streaks; sometimes the venter is almost entirely fuscous except for some yellow on the sides near the base. Halteres fuscous. Wings as figured; cell R hyaline, the apical spot nearly disconnected from the crossband, and the hyaline triangle broadly open posteriorly. Legs yellow; the trochanters, apical portion of front tibiae and entire tarsi, base of hind femora and sometimes the apex of the tibae, apical segments of middle and hind tarsi, black. Male: Differs from the female by the usual sex characters and by cell R being infuscated. The head is proportionately large.

Comparative Notes. C. wiedemanni is a distinct North American species. It has for many years been identified as *C. obsoleta* Wied., but is readily separated by the wing picture. In the female cell R is hyaline, in both sexes, the apical spot is narrowly joined to the crossband and usually extends but a little way into cell R_4, consequently the hyaline triangle is broadly open.

Remarks. The males (identified from reared specimens by Dr. H. H. Schwardt at the University of Arkansas) conform in all respects to Kröber's description of *C. fraterna.* It is quite evident that the infuscated cell R of this sex should make the association with the female improbable. I have not seen Kröber's type, but undoubtedly it is the same as his *C. wiedemanni.*

Type Data. Through the courtesy of the Museum of Vienna I received one type female for study. The specimen had been previously determined (by Wiedemann?) as *C. obsoletus.* From "Pennsylvanien, Coll. Winthem."

Distributional Data:

UNITED STATES: Maine 1, July 6; Massachusetts; Connecticut 1, Aug. 12; New York 4, July 19 - Aug. 16; New Jersey 3, July 12 - Sept. 8; Delaware 1, Aug. 3; Maryland 5, June - Aug. 13; District of Columbia 1, July 7; Virginia 3, July 13 - Aug. 1; North Carolina 1, July 10-17; South Carolina 1, Aug. 24; Georgia 2, July 25; Pennsylvania 3, July 6-19; Michigan 3, July 4-28; Ohio 8, June 13 - Aug. 1; Tennessee 1, July 10 - Aug. 31; Wisconsin 1, July 30; Illinois 3, July 10 - Aug. 12; Mississippi 4, July 14-17; Arkansas 3, April 16 (reared) Sept. 12.

In addition, reported by others from:

CANADA: Quebec, Ontario.

UNITED STATES: New Hampshire, Minnesota, Iowa, Louisiana, Nebraska.

Neochrysops Walton (1918)

1918. *Neochrysops* Walton, Proc. Ent. Soc. Wash., XX, 191.

Original Description. Hind tibiae bearing spurs; head much as in Chrysops, but antennae more slender; first joint subequal with the third which is but faintly swollen at base and bears five annuli; second segment slender and two thirds length of first. Eyes in life marked as in figure (four more or less triangular coalescent spots on the disc). Ocelli present, closely approximated; wings evenly infuscated throughout; anterior branch of third vein bearing a stump at its bend extending into second marginal cell; abdomen globose, much wider than thorax.

Genotype: N. globosa Walton (1918).

Remarks. Neochrysops is doubtfully a good genus. Bequaert (1930) includes it under Chrysops. There is so little evidence, insofar as there is but one specimen, that I prefer to let it stand as the original author intended.

Neochrysops globosa Walton (1918)

1918. *N. globosus* Walton, Proc. Ent. Soc. Wash., XX, 192.

Color. Yellow and black; abdominal dorsum with a double row of large black spots; wings uniformly infuscated.

Size. Length, 8 mm.

Structural and Color Characters. Female: Vertex, frons, an abbreviated mid-streak on the upper part of the frontoclypeus, and sides of genae, yellow pollinose; ocellar area, frontal callus, a large spot on each side of the yellowish frontoclypeus, another on the oral margins of the genae, black. Palpi yellow. Antennae very slender and elongate; the scape yellow, pedicel and base of flagellum brown-yellow, apical portion of flagellum black. Dorsum of thorax and scutellum yellow pollinose with pale yellowish pubescence, the former with three fuscous stripes, the median one extending part way onto the scutellum; pleurae and venter yellow pollinose with fuscous stripes, the former with sparse yellowish pile. Abdomen inflated, yellow, with black pubescence most dense at the lateral margins and the apex; the dorsum with a double row of more or less rounded large black spots beginning on the first segment, becoming on each succeeding segment somewhat smaller; venter wholly yellow. Halteres yellow. Wings uniformly infuscated, most saturate along the costal margin and the stigma; a stump at the bifurcation of vein R_{4+5}. Legs yellow; the trochanters, apices of tibiae, entire front tarsi, apical segments of middle and hind tarsi, black. Male: Unknown.

Comparative Notes. This species has close affinities with the genus Chrysops. It differs from the North American species of that genus by the wholly infuscated wings with a stump at the bifurcation of vein R_{4+5}, the inflated abdomen (Bequaert [1930] suggests that this condition may be due to the presence of a worm), the very long and slender antennae, and according to Walton (1918), the eye-marking consisting of four coalescent more or less diamond-shaped spots.

Type Data. Described from one female (up to now the only specimen represented in collections) from Cabin John Bridge, Maryland, July 20, 1916. In the United States National Museum.

Silvius Meigen (1820)

1820. *Silvius* Meigen, Syst. Beschreib. Europ. Zweifl. Ins., p. 27.
1922. *Perisilvius* Enderlein, Mitt. Zoöl. Mus. Berlin, X, 2, p. 344.

Generic Characters. Eyes bare, often with numerous brown spots, contiguous in the male, broadly separated in the female. Ocelli present. Frontal callus present in the female. Pedicel of antenna half or less the length of the scape; flagellum five segmented. Palpi a little more than half the length of the proboscis, which is a little shorter than the head.

Genotype: Tabanus vituli Fabricius (1805).

Remarks. All nearctic species of this genus are western in distribution.

KEY TO SPECIES

1. Wings maculate, species gray 2
Wings immaculate, species yellow 5
2. Costal cell infuscated .... *sayi* n. sp., p. 357
Costal cell not infuscated 3
3. Frontal callus distinctly more than half the width of vertex, narrowly separated from eyes .... *laticallus* n. sp., p. 353
Frontal callus about half the width of vertex, broadly separated from eyes 4
4. Veins R_4 and R_5 with subapical spots .... *quadrivittatus* (Say), p. 356
Veins R_4 and R_5 without subapical spots .... *pollinosus* Will., p. 355
5. Frontoclypeus entirely pruinose; abdominal tergites with conspicuous median triangles .... *microcephalus* Wehr., p. 354
Frontoclypeus partially denuded abdominal tergites without median triangles. *gigantulus* (Loew), p. 352

Silvius gigantulus (Loew) (1872)

(Plate XXXV, fig. 89)

1872. *Chrysops gigantulus* Loew, Cent., X, 12.
1877. *Silvius gigantulus* Osten Sacken, West. Dipt., p. 215.
1887. *S. gigantulus* Williston, Trans. Kans. Acad. Sci., X, 131.
1895. *S. gigantulus* Townsend, Proc. Cal. Acad. Sci., IV, 595.
1904. *S. gigantulus* Hine, Ohio Nat., V, 229.
1924. *S. gigantulus* Wehr, Neb. Univ. Studies, XXII, 110.

The following also refers to this species:

1875. *Silvius trifolium* Osten Sacken, Prodrome I, 395.

Color. Yellow.

Size. Length, 9 mm. to 11 mm.

Structural and Color Characters. Female: Vertex, frons, upper and lower limits of the yellow-brown frontoclypeus, and genae yellow pollinose; ocellar space more or less denuded, black; frontal callus subround or pear-shaped, shining black. Genae and post genae yellow pilose. Palpi tapering to a point, orange-yellow. Antennae variable as to color, typically orange-yellow except the black apical portion of the flagellum. Dorsum of thorax and scutellum fulvous pruinose with yellow pubescence; pleurae and venter gray pollinose, the former with dense yellow pile. Abdomen golden-yellow with black pubescence; usually a quadrate posteriorly emarginate black spot beneath the scutellum and an elongate black spot on the disc of the second tergite. Halteres yellow. Wings hyaline except the yellow costal cell and stigma; a stump at the bifurcation of vein R_{4+5}. Legs yellow; the trochanters, femoro-tibial joints, apex of front tibiae and entire tarsi, apices of middle and hind tarsi, fuscous. Male: Like the female except for sex characters, more densely pubescent and pilose, etc. The sexes are very easily associated.

Comparative Notes. Separated from *S. microcephalus* Wehr by the denuded areas on the frontoclypeus, the head larger in relation to the thorax, and the lack of middorsal triangles.

Remarks. There is at hand a series which I am sure belongs to this species, but the black spot of the first and second abdominal tergites is lacking, and in general the specimens are somewhat smaller. I do not feel that I have sufficient evidence to raise this form to varietal rank.

Type Data. Described from California. One female in the Museum of Comparative Zoölogy, Cambridge, Mass.

Distributional Data:

CANADA: British Columbia 5, July 15 - Aug. 10.

UNITED STATES: Washington 6, July 15 - Aug.; Oregon 1, July 27; California 14, May 27 - Aug. 23; Idaho 1; Montana 1, Aug. 11.

In addition, reported by others from:

UNITED STATES: Colorado, New Mexico, Nevada.

Silvius laticallus, new species

(Plate XXXVI, figs. 95,101)

Color. Gray, with conspicuous black abdominal figures.

Size. Length, 7 mm. to 8 mm.

Structural and Color Characters. Female: Vertex, frons, frontoclypeus, and genae pale gray pollinose, the pits on the sides of the frontoclypeus denuded, brown; ocelli reddish; frontal callus broad, equal to at least three fourths the width of the vertex, shining black, a narrow line extending from the upper margin to the median ocellus. Palpi stout, dorsolaterally grooved, brown with grayish pollen; antennae mostly black, the basal segments with a grayish pruinosity, the extreme base of the scape and flagellum reddish. Dorsum of thorax and scutellum black, gray pruinose, the former with three narrow lighter gray pollinose stripes; pleurae and venter gray-black, pruinose, the former with white pile. Dorsum of abdomen gray; a broad quadrate black spot beneath the scutellum, posteriorly emarginate, not reaching the hind margin of the first segment; segments II to V each with a heavy black more or less double geminate figure whose inner portions are the broader and whose outer portions are more strongly divergent; the sixth segment more or less corresponds to the pattern on the preceding segments; the seventh segment blackish with the hind margin gray, venter of abdomen gray; a black lateral spot present or absent on each of segments V and VI. Halteres brown. Wings hyaline; the stigma brown, and the bifurcation of vein R_{4+5} and the cross veins brown maculate. Legs brown-yellow; the trochanters, apices of femora and tibiae, and tarsi (only the apices of the middle and hind metatarsi), fuscous. Male: Similar to the female except for sex characters. Densely gray-white pilose. Dorsum of abdomen yellowish in ground color instead of the typical gray of the female, the black abdominal pattern as in the female.

Comparative Notes. Differs from other nearctic species of Silvius by the conspicuous dorsolateral grooves of the stout palpi and the broad frontal callus.

Type Data. Holotype, female, Hermiston, Oregon, July 9, 1922; A. L. Melander. Allotype, male, Los Angeles Co., California. Paratypes, one female, San Diego, California, May; E. P. Van Duzee; one female and one male, Los Angeles Co., California. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

Silvius microcephalus Wehr (1924)

1924. *S. microcephalus* Wehr, Neb. Univ. Studies, XXII, 109.

Color. Yellow; abdominal dorsum with a median row of whitish triangles.

Size. Length, 9.5 mm. to 11 mm.

Structural and Color Characters. Female: Head small as compared to the thorax. Vertex, frons, frontoclypeus and genae yellow pollinose; only the pits on each side of the frontoclypeus denuded, yellow-brown; frontal callus subround, black. Palpi slender, orange-yellow; antennae yellow, except the black apical portion of the flagellum, the scape and pedicel black pubescent. Dorsum of thorax and scutellum fulvous pollinose; pleurae and venter yellow-gray pollinose, the former with short yellow pile. Abdomen yellow with black and some pale pubescence, the dorsum with a median row of large whitish triangles apparently placed upon a dark mid-stripe. Halteres yellow. Wings hyaline, except the yellow costal cell and stigma, bifurcation of vein R_{4+5} with a stump. Legs yellow; apices of tibiae femoro-tibial joints, front tarsi, apical portions of middle and hind tarsi, fuscous. Male: I have but one poorly preserved specimen at hand. It is undoubtedly the male of this species. Similar to the female except for sex characters, more densely pilose; the thoracic dorsum and scutellum more gray than fulvous. The wholly pollinosed frontoclypeus and genae along with the dorsal abdominal markings easily associate the sexes.

Comparative Notes. To be separated from *S. gigantulus* (Loew) according to the key. See, also, under description of that species. In general the yellow coloration of *S. microcephalus* is more pale than that of *S. gigantulus*, although this is by no means a safe character. Attempting to separate these two species by the size of the head in proportion to the body does not appear reliable.

Type Data. Described from two females, Ute Creek, Costilla county, Colorado, August 7, 1907. In the University of Nebraska Collection. My identification is based on a specimen labeled "Paratype," in the Ohio State Museum.

Distributional Data:

UNITED STATES: Colorado: Mountain Home Lake, Fort Garland, 8.300 ft., July 20-25, 1932; Riley, August, 1890.

Silvius pollinosus Williston (1880)

(Plate XXXVI, fig. 104)

1880. *S. pollinosus* Williston, Trans. Conn. Acad. A. and S., IV, 244.
1887. *S. pollinosus* Williston, Trans. Kans. Acad. Sci., X, 131.
1903. *S. pollinosus* Snow, Kans. Univ. Sci. Bull., II, 213.
1924. *S. pollinosus* Wehr, Neb. Univ. Studies, XXII, 110.

Color. Gray pollinose; black abdominal spots obscure; wings spotted.

Size. Length, 9 mm. to 10.5 mm.

Structural and Color Characters. Female: Vertex, frons, frontoclypeus, and genae pale gray pollinose; the black suboval frontal callus equals about one half the width of the vertex; the pit on each side of the frontoclypeus denuded, black. Palpi reddish, the outer surfaces with some black. Antennae mostly black; scape and pedicel sometimes reddish at their bases, grayish pruinose. Entire body pale-gray pollinose; the dorsum of the thorax striped rather faintly with alternate light and dark; the abdominal dorsum with an obscure double row of median black angulate spots most visible on segments II to IV. All pilosity and pubescence, white. Halteres black. Wings hyaline; the stigma brown, also brown spots at the cross veins and bifurcation of vein R_{4+5}. See figure. Legs yellow; the front coxae gray pollinose; the joints, apices of tibiae and front and middle femora, practically the entire hind femora, all the tarsi, except the yellow bases of the metatarsi, fuscous. Male: Differs from the female by being less heavily pollinosed, hence the dorsum of the thorax and scutellum more blackish. The black abdominal spots are more conspicuous; the sides of the abdomen near the base are yellowish. Wings like the female. Legs like the female, except that all the femora are fuscous. All pilosity and pubescence more dense than in the female.

Comparative Notes. The very heavy pruinosity of this species is quite characteristic. Separated from *S. laticallus* n. sp. by the abdominal pattern, smaller frontal callus, slender palpi, fuscous hind femora, etc. From *S. quadrivittatus* (Say), *S. pollinosus* is separated according to the key, and in addition, by its pollinosity, by the abdominal dorsum having two rows of black spots instead of four, its larger size, and in the male, the femora are entirely fuscous. Also see under description of *S. quadrivittatus.*

Type Data. Described from Western Kansas. One female (antennae and one wing missing, coloration good) in the Francis Huntington Snow Entomological Collection of the University of Kansas.

Distributional Data:

UNITED STATES: South Dakota 3, June 19 - July 9; Kansas 4, June - August; Oklahoma 1, Aug. 2; Colorado 2, July 2 - Sept. 22; New Mexico 2, June 22; Utah; Arizona 1, July 22.

In addition, reported by others from:

UNITED STATES: Nebraska.

Silvius quadrivittatus (Say) (1823)

(Plate XXXVI, fig. 103)

1823. *Chrysops quadrivittatus* Say, Jl. Acad. N. S. Phil., III, 33.
1828. *C. quadrivittatus* Wiedemann, Auss. Zw. I, 200.
1859. *C. quadrivittatus* Say, Comp. Works, II, 54.
1887. *Silvius quadrivittatus* Williston, Trans. Kans. Acad. Sci., X, 131.
1895. *S. quadrivittatus* Townsend, Trans. Am. Ent. Soc., XXII, 57.
1904. *S. quadrivittatus* Hine, Ohio Nat., V, 229.
1924. *S. quadrivittatus* Wehr, Neb. Univ. Studies, XXII, 110.
1931. *S. quadrivittatus* Philip, Minn. Tech. Bull., LXXX, 95.

The following also refers to this species:

1892. *Diachlorus notatus* Bigot, Mem. Soc. Zoöl. France, V, 223.

Color. Gray or yellow-gray; abdominal dorsum with four rows of spots; wings spotted.

Size. Length, 7 mm. to 10 mm.

Structural and Color Characters. Female: Vertex, frons, frontoclypeus and genae yellowish-gray pollinose; frontal callus black, one half the width of the vertex; the pit on each side of the frontoclypeus denuded, black. Palpi reddish with some black, especially on the outer surfaces. Antennae variable; sometimes mostly black except the reddish bases of the segments, sometimes mostly reddish or yellow, only the apex of the flagellum black. Dorsum of thorax and scutellum yellow-gray pollinose, the former with alternate light and dark stripes; pleurae and venter gray pollinose. Dorsum of abdomen yellow-gray or gray pollinose with four rows of black vittate spots. Venter of abdomen gray with a faint suggestion of a dark broken median stripe and a lateral one. Halteres black. Wings hyaline; the stigma brown, and brown spots typically distributed according to the figure. Legs yellow; the front coxae grayish pollinose; the trochanters, apices of femora and tibiae, and the tarsi (except the yellow bases of the metatarsi), fuscous. Male: Similar to the female except for sex characters. The abdomen is more yellowish. The three rows of vittate spots on the venter are quite distinct.

Comparative Notes. Separated from related species according to the key. Also, see under description of *S. pollinosus* Will. In addition, in the male, the abdomen of *S. quadrivittatus* is considerably more yellow than in *S. pollinosus*.

Type Data. Described from near the Rocky Mountains. The types are destroyed.

Distributional Data:

United States: South Dakota 3, July 21; Nebraska 1, July 10; Kansas 3, June; Oklahoma 3, June 26 - Aug. 16; Texas 3, June 3 - July 18; Montana 1, July 11; Wyoming; Colorado 2, July 9 - Aug. 12; New Mexico 5, June 10 - Aug. 7; Utah 2, June 28 - Aug. 13; Arizona 1, Aug.

In addition, reported by others from:

United States: Minnesota, California.

Silvius sayi, new species

(Plate XXXVI, figs. 98, 102)

Color. Gray with maculate wings and abdomen.

Size. Length, 7 mm. to 8.5 mm.

Structural and Color Characters. Female: Vertex, frons, genae and frontoclypeus (except the denuded piceous pits on the sides of the latter), gray pollinose; ocelli reddish; frontal callus shining black, often a narrow line extending from its upper margin to the median ocellus. Antennae reddish except for the black annulate portion of the flagellum, the scape and pedicel with a grayish pruinosity; palpi reddish-brown with gray pruinosity. Dorsum of thorax and scutellum black gray pruinose, the former with the usual pale-gray pollinose stripes; pleurae and venter gray pollinose with sparse white pile. Dorsum of abdomen gray, a broad quadrate black spot beneath the scutellum, not attaining the hind margin of the first segment; segments II to V with a row of black geminate figures (these are exhibited in varying degree dependent on the distribution of pollinosity), remaining segments black with gray hind margins. Venter of abdomen gray. Halteres brown. Wings hyaline except for the infuscated costal cell and maculate areas. Legs brown, basal portions of front and middle tibiae, and middle and hind metatarsi, yellow.

Comparative Notes. This is the only nearctic *Silvius* with maculate wings and infuscated costal cell, by which it is immediately separated from related forms (*S. laticallus* n. sp., *S. quadrivittatus* [Say] and *S. pollinosus* Will.).

Type Data. Holotype, female, Texas. Paratypes, two females, Texas; two females, Los Angeles Co., California; one female, San Diego, Texas, June 29, 1930, H. M. Smith. Holotype and three paratypes in the United States National Museum, catalog No. 50504; two paratypes in the Francis Huntington Snow Entomological Collection of the University of Kansas.

Esenbeckia Rondani (1864)

1864. *Esenbeckia* Rondani, Arch. Zoöl. Modena, III, 84.

Generic Characters. Eyes bare, contiguous in the male, narrowly separated in the female. Ocelli present. Frontal callus absent. Flagellum of antenna eight-segmented. Proboscis about as long as the head or slightly longer. Palpi about one third or more the length of the proboscis. Cell R_5 of the wings petiolate.

Genotype. *Silvius vulpes* Wiedemann (1828).

KEY TO SPECIES

1. Yellow brown; pile of head and thorax yellow; legs yellow; in the male no definite demarcation between the large and small facets of the eyes.
incisuralis (Say), p. 359

Gray brown; pile of head and thorax grayish white; legs brown; a distinct line marks the transition from large to small facets in the eyes of the male.
delta (Hine), p. 358

Esenbeckia delta (Hine) (1920)

1920. *Pangonia delta* Hine, Ohio Jl. Sci., XX, 313.
1925. *Pangonia delta* Hine, Occ. Pap. Mus Zoö. Mich., No. 162, 6.

The following also refers to this species:

1904. *Pangonia saussurei* Hine, Ohio Nat., V, 228.

Color. Gray brown (this apparent color produced by a whitish pruinosity on a light brown ground).

Size. Length, 16 mm.

Structural and Color Characters. Male: Frontal triangle, frontoclypeus and genae gray white pollinose; genae and postgenae white pilose. Palpi yellow with black hairs. Antennae yellow, the two basal segments with black hairs, the pedicel about half the length of the scape. Thorax pale gray brown pruinose with white pubescence and pile in the usual places. Abdomen more or less uniformly gray-brown, the sides of the segments darker apically. Halteres light brown. Wings subhyaline with a light-brown tinge, more saturate in the costal regions; veins light brown; the bifurcation of vein R_{4+5} with a stump. Legs practically uniformly brown with black hairs except for the whitish pollinose front coxae, which are white pilose. Female: Not available for description. According to my notes, the sexes are easily associated.

Comparative Notes. Separated from *E. incisuralis* (Say) according to the key. In addition, the black hairs of the legs of *E. delta* and the yellow hairs of the legs of *E. incisuralis* offer good characters.

Remarks. My description is based on a homotype male.

Type Data. Two males and one female, Huachuca Mountains and Palmerlee, Arizona. In the Ohio State Museum, Columbus, Ohio.

Distributional Data:

UNITED STATES: Arizona: Huachuca Mts., Aug. 1, 1927; Chiricahua Mts., Aug. 3.

Esenbeckia incisuralis (Say) (1823)

(Plate XXIX, fig. 1; Plate XXXV, fig. 78)

1823. *Pangonia incisuralis* Say, Jl. Acad. N. S. Phil., III, 31.
P. incisuralis Say, Amer. Ent., pl. XXXIV.
1859. *P. incisuralis* Say, Comp. Works, I, 75.
1887. *P. incisuralis* Williston, Trans. Kans. Acad. Sci., X, 130.

The following also refer to this species:

1828. *P. incisa* Wiedemann, Auss. Zw. 1, 90.
1904. *P. incisa* Hine, Ohio Nat., V, 228.

Color. Fuscous and yellow, the former usually dominant.

Size. Length, 14 mm. to 16 mm.

Structural and Color Characters. Female: Vertex, frontoclypeus and genae fulvous pruinose. Palpi and antennae orange-yellow, the pedicel of the latter not more than half the length of the scape. Genae and postgenae yellow pilose. Dorsum of thorax and scutellum fuscous, yellow pubescent; pleurae and venter fuscous, yellow pilose. Dorsum of abdomen fuscous, the hind margins of all the segments and the sides of the first two, yellow, the yellow pubescence most dense on the hind margins; venter mostly fuscous, the segments with yellow hind margins. The yellow of the abdomen is of variable extent, sometimes occupying considerably more than the sides of tergites I and II. Halteres brown-yellow. Wings subhyaline with a yellow tinge most saturate in the costal regions; veins yellow; a stump usually present at the bifurcation of vein R_{4+5}. Legs yellow with yellow hairs, the front coxae and basal portions of all femora fuscous. Male: Like the female except for the usual sex characters.

Comparative Notes. Separated from *E. delta* (Hine) according to the key.

Type Data. Described from "Arkansas." The types are destroyed.

Distributional Data:

UNITED STATES: Kansas: Chautauqua Co., Cowley Co., 1916. Oklahoma: Stillwater, June 20, 1932. Texas: Gurley, May 28, 1905. New Mexico: Van Houten Canyon, Aug. 1, 1914; Eagle Trail Mt., Aug. 9, 1914.

In addition, reported by others from:

UNITED STATES: Arkansas.

Stonemyia, new genus

Generic Characters. Head in lateral aspect, convex. Eyes bare or hairy, contiguous in the male, separated in the female. Ocelli present. Frontal callus absent in female. Vertex relatively narrow, sides parallel to inner angles of eyes. Flagellum of antenna eight-segmented. Proboscis of variable length, averaging about the length of the head. Palpi very slender, one third to one half the length of the proboscis. Cell R_5 of wing open.

Comparative Notes. In the new world fauna Stonemyia is perhaps most closely related to Esenbeckia Rond., but from this is readily separated by open cell R_5. Buplex Austen (Pl. XXXVI, figs. 96, 99) of the old world is structurally akin to Stonemyia (Pl. XXXVI, figs. 94, 97) except that the palpi are not slender at the base and are dorsally grooved, and the inner margins of eyes not angulate.

Remarks. This genus, named in honor of Dr. Alan Stone, who suggested the possibilities whereby a logical new group could be set up, is established to receive a small number of species, all of long standing, but which have been shunted about from one genus to another seemingly in an aimless fashion. The genus to which these species have most recently been relegated is Buplex Austen, but this genus is confined solely to Africa. From the standpoint of geographical distribution alone it appears that the gap between Buplex and Stonemyia is too wide to be reconciled. With this in addition to the structural characters already mentioned it should at once be apparent that there is a basis for erecting a new genus.

For the genotype I select Osten Sacken's *Pangonia tranquilla.*

KEY TO SPECIES

1. Eyes hairy, at least in male (*Pilimas*) 2
   Eyes bare (*Stonemyia*) 3
2. Wings blackish .... *jonesi* (Cresson), p. 367
   Wings yellowish .... *californica* (Bigot), p. 366
3. Yellow species (including antennae and legs) 4
   Not yellow species 5
4. Pedicel more than half the length of the scape; the bifurcation of vein R_{4+5} without a stump .... *pigra* (O. S.), p. 362
   Pedicel not more than half the length of the scape, usually less; the bifurcation of vein R_{4+5} with a stump .... *ruficornis* (Bigot), p. 364
5. Length of proboscis equals width of head; palpi black .... *fera* (Will.), p. 361
   Length of proboscis noticeably less than width of head; palpi not black 6
6. All femora black; abdomen with yellowish pubescence .... *tranquilla* (O. S.), p. 365
   All femora ferruginous; abdomen with grayish pubescence .... *rasa* (Loew), p. 363

Subgenus *Stonemyia* s. str.

In this group are included all species with eyes bare.

Stonemyia (Stonemyia) fera (Williston) (1887)

1887. *Pangonia fera* Williston, Trans. Kans. Acad. Sci., X, 130.
1904. *P. fera* Hine, Ohio Nat., V, 227.
1921. *Corizoneura fera* Surcouf, Gen. Ins., CLXXV, 134.
1924. *Buplex fera* Bequaert, Psyche, XXXI, 33.

Color. Predominantly fuscous; sides of abdomen brown-yellow, hind margins of tergites pale; antennae, palpi, and legs black.

Size. Length, 12 mm. to 13 mm.

Structural and Color Characters. Female: Vertex, frontoclypeus and genae yellow-gray pollinose. Antennae and palpi black. Proboscis black, its length equal to the width of the head. Genae and postgenae with dense yellowish pile. Dorsum of thorax and scutellum fuscous to black with a variable amount of gray pruinosity, the former with faint gray stripes; pleurae and venter gray pruinose, the former densely yellow pilose. Abdomen fuscous with black and pale pubescence; broadly brown-yellow on the sides, especially near the base; hind margins of the segments whitish. Sometimes the second and third tergites are practically entirely brown-yellow except for a very small black median spot; sometimes all of the segments of the venter are fuscous with pale hind margins, usually the second is predominantly brown-yellow, and often the third. Halteres black. Wings subhyaline; stigma brown, costal area yellowish; usually no stump at the bifurcation of vein R_{4+5}. Legs black. Male: Like the female except the usual sex characters.

Comparative Notes. The long proboscis and black antennae, palpi and legs make this species readily recognized. Some forms of the eastern *S. tranquilla* (O. S.) bear striking similarities, but neither the palpi nor the legs are wholly black and the proboscis is not so long.

Type Data. Described from one male, Mt. Hood, Oregon. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

Distributional Data:

UNITED STATES: Washington, July 22 - Oct. ?8; Oregon 1, July 18, California 3, July 16 - 28; Idaho 1, June 20.

In addition, reported by others from:

CANADA: British Columbia.

Stonemyia (*Stonemyia*) *pigra* (Osten Sacken) (1875)

1875. *Pangonia pigra* Osten Sacken, Prodrome I, 367.
1918. *P. pigra* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 191.
1928. *Buplex pigra* Leonard, N. Y. State List, p. 754.

Color. Yellow.

Size. Length, 11 mm. to 12 mm.

Structural and Color Characters. Female: Vertex convex anteriorly, gray-yellow pollinose; frontoclypeus and genae gray-yellow pollinose. Antennae yellow, the pedicel more than half the length of the scape. Palpi slender, yellow. Proboscis shorter than the head. Thorax gray-yellow pollinose with whitish-yellow pubescence and pile. Abdomen brown-yellow; the hind margins of the segments appear lighter due to yellowish pubescence. Wings hyaline, except the yellow stigma and costal area; no stump at the bifurcation of vein R_{4+5}. Halteres brown-yellow. Legs uniformly brown-yellow. Male: Similar to the female in all respects except for sex characters and more dense pubescence and pilosity.

Comparative Notes. Separated from all other eastern species by its yellow color. From *S. ruficornis* (Big.), a western species, it is easily distinguished by the absence of a stump at the bifurcation of vein R_{4+5} and the pedicel being more than half as long as the scape.

Type Data. Described from two females and one male, Kentucky and New York. Two females in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

United States: New Jersey 1, July 12; Maryland 1, June 25; District of Columbia 1, June 14; Virginia 3, June 11 - July 2.

In addition, reported by others from:

United States: New York, Kentucky.

Stonemyia (*Stonemyia*) *rasa* (Loew) (1869)

1869. *Pangonia rasa* Loew, Cent., VIII, 7.
1875. *P. rasa* Osten Sacken, Prodrome I, 366.
1887. *P. rasa* Williston, Trans. Kans. Acad. Sci., X, 130.
1901. *P. rasa* Hine, Ohio Nat., II, 169.
1903. *P. rasa* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, 45.
1918. *P. rasa* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 191.
1924. *Buplex rasa* Bequaert, Psyche, XXXI, 33.
1931. *B. rasa* Philip, Minn. Tech. Bull., LXXX, 95.

The following also refers to this species:

?1905. *Pangonia tranquilla* Washburn, 10th Rept. State Ent. Minn., 79.

Color. Brown; hind margins of abdominal segments pale; pubescence and pilosity light gray.

Size. Length, 10.5 mm. to 14 mm.

Structural and Color Characters. Female: Vertex, frontoclypeus and genae pale-gray pollinose. Scape, pedicel and extreme base of flagellum yellow-brown or reddish, apical portion of flagellum fuscous. Palpi slender, yellow. Proboscis about equal to the length of the head, distinctly less than the width. Genae and postgenae gray-white pilose. Dorsum of thorax and scutellum brown with gray pruinosity, the former with alternate light and dark stripes; pleurae and venter gray pruinose, the former densely pale-gray pilose. Abdomen chestnut brown, light-gray pubescent, especially on the whitish hind margins of the segments. Halteres fuscous. Wings subhyaline; stigma brown and a suggestion of dilute yellow in the costal areas; no stump at the bifurcation of vein R_{4+5}. Legs ferruginous; the coxae and femora with white pile, the tibiae and tarsi with short black pubescence. Male: Somewhat darker than the female; the costal areas of the wings more distinctly yellow and the legs darker; in other respects, except for sex characters, very readily associated with the female.

Comparative Notes. Separated from *S. tranquilla* (O. S.) according to the key. In addition the palpi are more yellow, the costal cell of the wing more dilute yellow, and the general color chestnut brown as opposed to the fuscous and yellow-brown of *S. tranquilla.*

Type Data. Described from the female with Wisconsin as the type locality. In the Museum of Berlin.

Distributional Data:

CANADA: Quebec 1, July 1.

UNITED STATES: Massachusetts 2, Aug. 8-28; New Hampshire 1; Connecticut 2, Aug. 10-12; New York 3, June - Aug. 27; Maryland 1, Aug. 14; Ohio 4, Aug. 21-30; Illinois 1, July 24.

In addition, reported by others from:

UNITED STATES: Maine, New Jersey, Wisconsin.

Stonemyia (*Stonemyia*) *ruficornis* (Bigot) (1892)

1892. *Corizoneura ruficornis* Bigot, Mem. Soc. Zoöl. France, V, 615.
1904. *Pangonia ruficornis* Hine, Ohio Nat., V, 228.
1921. *Corizoneura ruficornis* Surcouf, Gen. Ins., CLXXV, 134.

Color. Yellow.

Size. Length, 12 mm. to 14 mm.

Structural and Color Characters. Female: Vertex concave anteriorly, yellow pollinose; frontoclypeus and genae yellow pollinose. Antennae yellow, the pedicel not more than half the length of the scape. Palpi attenuate, yellow. Proboscis less than the length of the head. Thorax gray-yellow pollinose with yellow pubescence and pilosity. Dorsum of abdomen brown-yellow; venter variable, usually yellow with the apical segments blackish with yellow hind margins. Halteres yellow. Wings hyaline, yellow along the costal areas; a stump at the bifurcation of vein R_{4+5}. Legs uniformly yellow. Male: Like the female except the usual sex characters and more dense pubescence and pilosity.

Comparative Notes. A distinct western species. Separated from *S. pigra* (O. S.) according to the key. Also see under description of that species. In addition *S. ruficornis* is somewhat larger and more slender and the anterior vertex is noticeably concave.

Type Data. Described from two males, California.

In the British Museum.

Distributional Data:

UNITED STATES: Wyoming: Yellowstone, August. California: Cuyamaca Lake, July 6, 1929; Los Angeles Co., May; Dulzura, June 14, 1917; Calaveras Co.; Palo Alto, July 27, 1891; Fredalba, July 21, 1912.

Stonemyia (*Stonemyia*) *tranquilla* (Osten Sacken) (1875)

(Plate XXXVI, figs. 94, 97)

1875. *Pangonia tranquilla* Osten Sacken, Prodrome I, 367.
1887. *P. tranquilla* Williston, Trans. Kans. Acad. Sci., X, 130.
1902. *P. tranquilla* Howard, Ins. Book, pl. XVI, f. 7.
1921. *Corizoneura tranquilla* Surcouf, Gen. Ins. CLXXV, 134.
1924. *Buplex tranquilla* Bequaert, Psyche, XXXI, 33.
1927. *B. tranquilla* Johnson, Ins. Mt. Des. Reg., p. 179.

Color. Yellow-brown; the abdomen more or less predominated with fuscous.

Size. Length, 10.5 mm. to 14.5 mm.

Structural and Color Characters. Female: Vertex, frontoclypeus and genae, yellow-gray pollinose. Genae and postgenae yellowish pilose. Palpi slender, ferruginous with a little fuscous showing through. Antennae black; sometimes the base of the flagellum reddish. Proboscis not usually longer than the head, always less than the width of the head. Dorsum of thorax and scutellum fuscous, gray pruinose, the former with alternate light and dark stripes; pleurae and venter gray pollinose, the former densely yellow pilose. Dorsum of abdomen yellow-brown on the sides, especially on tergites II and III, and sometimes IV; elsewhere fuscous, the tergites with yellowish hind margins. Venter of abdomen usually with segments II and III yellow-brown and the remaining segments fuscous with yellow hind margins. Entire abdomen yellow pubescent, especially the hind margins of the segments. Halteres fuscous. Wings subhyaline; the stigma brown and costal cells yellow; bifurcation of vein R_{4+5} without a stump. Legs black; the femorotibial joints and basal portions of tarsal segments, red-brown; sometimes the basal portion of the front tibiae and entire middle and hind tibiae red-brown. Male: Similar to the female except for sex characters and generally darker.

Comparative Notes. Separated from *S. rasa* (Loew) according to key characters. Also, see under description of *S. rasa.* In addition the antennae of *S. tranquilla* are almost entirely black and the proboscis frequently longer in proportion to the head.

Type Data. Described from one male and two females. Habitat given as Canada, Massachusetts, White Mountains and Middle States. The three type specimens are in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Distributional Data:

UNITED STATES: Maine 3, July 25 - Aug. 17; New Hampshire 5, August; Vermont 1, Aug. 15; Connecticut 1; New York 6, July 13 - Aug. 12; Michigan 1, Aug. 4.

In addition, reported by others from:

CANADA: Nova Scotia, Quebec.
UNITED STATES: Pennsylvania.

Subgenus *Pilimas,* new subgenus

I have erected this subgenus to receive two species of hitherto uncertain generic status, with eyes hairy, at least in the male.

Stonemyia (*Pilimas*) *californica* (Bigot) (1892)

(Plate XXIX, fig. 3)

1892. *Diatomineura californica* Bigot, Mem. Soc. Zoöl. France, V, 618.

The following also refer to this species:

1887. *Pangonia dives* Williston, Trans. Kans. Acad. Sci., X, 130 (preoc.).
1904. *P. dives* Hine, Ohio Nat., V, 227; *D. californica* Big. a syn.
1921. *Diatomineura dives* Surcouf, Gen. Ins., CLXXV, 131.

Color. Brown-yellow; the anterior margins of the abdominal tergites more or less fuscous.

Size. Length, 13 mm. to 16 mm.

Structural and Color Characters. Female: Vertex, frontoclypeus and genae fulvous pollinose; genae and postgenae whitish-yellow pilose. Palpi slender, orange-yellow with black hairs. Antennae orange-yellow except the black apical half of the flagellum, the scape and pedicel with black hairs. Dorsum of thorax and scutellum fulvous pollinose, yellow pubescent; pleurae and venter grayish pruinose with yellow to white-yellow pile. Dorsum of abdomen brown-yellow; the broad anterior margins of tergites I and IV to VII fuscous; tergites II and III with a small fuscous median spot, rarely their whole anterior margins fuscous; apex, sides and discs of tergites with black pubescence, the hind margins of the segments yellow pubescent. Venter of abdomen variable; usually brown-yellow at the base and fuscous apically, sometimes almost entirely fuscous with yellow at the sides near the base and on the hind margins of the segments. Halteres brown. Wings subhyaline, the costal cell yellow; a stump at the bifurcation of vein R_{4+5}. Legs ferruginous; the front coxae, apex of front tibiae and entire tarsi, bases of all femora, apical segments of middle and hind tarsi, fuscous. Male: Like the female except for sex characters.

Comparative Notes. A distinct western species. Separated from congeneric species according to the key.

Remarks. Hine (1904) has indicated the synonymy of *Pangonia dives* Will. (1887) and *Diatomineura californica* Bigot (1892).

However, there is an earlier *Pangonia dives* of Macquart (1857), Dipt. Exot., Suppl. I, p. 25. Therefore Bigot's name must stand.

Type Data. Described from California. In the British Museum. I have studied the Williston types of *Pangonia dives,* two females and one male, California, in the Francis Huntington Snow Entomological Collection of the University of Kansas.

Distributional Data:

UNITED STATES: Washington 1, July 24; Oregon 1, July 17; California 3, June 30 - July 28; Idaho 2, July; Utah 1, July 3.

Stonemyia (*Pilimas*) *jonesi* (Cresson) (1919)

1919. *Silvius jonesi* Cresson, Proc. Acad. N. S. Phil., 175.

I have not seen this species. However, it may be of interest to include the original description along with the notes which Dr. J. Bequaert made from the types.

Original Description. In general appearance this interesting species does not suggest any affinity with *gigantulus* Loew, but more critical examination makes it reasonably certain that it belongs to a group including that species and is very distinct from any yet described, to my knowledge. It is much larger than that species and the abdomen has black or dark bases to all segments. The tibial and antennal characters certainly place this species in Silvius, although in general appearance it suggests some of those in Pangonia. The eyes are uniformly green when moistened. Male: black; antennae except four black terminal annuli of third joint, palpi, abdomen except dark bases of dorsal and ventral segments especially towards apex of abdomen, femora except bases, bases of tibiae tawny, or brown. Halteres pale. Wings blackish, more intense along costa. Subopaque. Yellow pruinose above, becoming gray below. All pile on head and thorax yellow and rather abundant, also on the narrow apices of abdominal segments; the broad bases of the segments with appressed black pile, similar on venter. Femora with pale pile, which on the tibiae becomes darker. Pile on first antennal joint and base of palpi, yellow; on second, and apices of palpi, black. No mesonotal vittae. No denuded areas on face. Proboscis not longer than head, and palpi is slightly more than half as long as proboscis. First antennal joint twice as long as second; third twice as long as first and second together; the thickened basal annulus nearly broad as long, the following annuli together as long as the basal one. Neuration as in *gigantulus*.

Length, 17 mm. Female: Similar, but frons twice as broad as width of antennae, entirely pruinose. Mesonotum more grayish.

Type. Male: Keddie, Plumas county, California, July 6, 1918 (F. M. Jones), (A. N. S. P. No. 61977). Paratype. One female; topotypical.

Bequaert's Notes. Type male and allotype female. A large Pangonia-like species, but the third antennal segment five-jointed only, the basal portion (or first segment) being superficially divided into four parts (then eight joints in all). The two basal antennal segments as in Pangoniinae. The antennae are more like those of Tabanus than any other Pangoniinae known to me. There are two very long spurs on the hind tibiae. In the male the eyes are distinctly hairy, in the female they are bare. The face is short convex (not snout-like) and without shiny callosities. Ocelli present. Frons without callosity. Proboscis about as long as height of head. Palpi slender and narrowly pointed, longer than half the proboscis in female, in the male very little shorter than the proboscis. Anal cell closed; all posterior cells open. A distinct appendix to the upper branch of the fourth vein. Tarsi of male normal. In Enderlein's key it runs to Silviini, but it is certainly not a Silvius. I regard it as an aberrant species of Scaptia, in which the divisions of the base of the third segment of the antenna are more fused than usual in the genus and the eyes are hairy in the male only.

Goniops Aldrich (1892)

1892. *Goniops* Aldrich, Psyche, VI, 236.

Generic Characters. Eyes bare, holoptic in the male, dichoptic in the female, in the latter very small and narrow, acutely angulate above, the width of one being less than that of the broad vertex. Ocelli present. Vertex broad, gradually convergent above. Antennal prominence conspicuous, slightly exceeding the frontoclypeus. Flagellum of antenna eight-segmented, the basal segment more or less disc-shaped. Palpi at least three fourths the length of the proboscis, which is distinctly shorter than the head. Cell R_5 of the wings broadly open.

Genotype. *Pangonia chrysocoma* Osten Sacken (1875).

Remarks. Up to the present this genus is represented by one species only. It is doubtful whether or not the infuscation of the anterior portion of the wings is of any generic value.

Goniops chrysocoma (Osten Sacken) (1875)

(Plate XXIX, fig. 10; Plate XXXV, fig. 77)

1875. *Pangonia chrysocoma* Osten Sacken, Prodrome I, 368.
1887. *P. chrysocoma* Williston, Trans. Kans. Acad. Sci., X, 130.
1900. *Goniops chrysocoma* Hine, Ent. News, XI, 392 (syn.).
1901. *G. chrysocoma* Hine, Ohio Nat., II, 168.
1903. *G. chrysocoma* Hine, Ohio St. Acad. Sci. Spec. Pap. No. 5, 46.
1903. *G. chrysocoma* Malloch, Bull. Ill. State Lab. N. H., XII, 356.
1908. *G. chrysocoma* Walton, Ent. News, XIX, 464 (biol.).
1911. *G. chrysocoma* McAtee, Proc. Ent. Soc. Wash., XIII, 21-29 (biol.).
1918. *G. chrysocoma* McAtee and Walton, Proc. Ent. Soc. Wash., XX, 191.
1920. *G. chrysocoma* Marchand, Mon. Rock. Inst., No. 13, p. 56.
1921. *G. chrysocoma* Surcouf, Gen. Ins., CLXXV, 104.
1930. *G. chrysocoma* Schwardt and Hall, Bull. 256, Ark. Exp. Sta., p. 26.
1930. *G. chrysocoma* Stone, Ann. Ent. Soc. Am., XXIII, 293 (biol.).
1934. *G. chrysocoma* Schwardt, Jl. Kans. Ent. Soc., VII, 73 (biol.).

The following also refers to this species:

1892. *Goniops hippoboscoides* Aldrich, Psyche, VI, 236.

Color. Female, straw-yellow; male, dark brown; large anterior portion of wings infuscated.

Size. Length, 9.5 mm. to 14 mm.

Structural and Color Characters. Female: Vertex, genae, and occiput yellow pollinose, the first more or less denuded on the disc. Frontoclypeus yellow; bare. Palpi and antennae yellow, the former with conspicuous black pubescence. Proboscis brown-yellow. Entire body straw-yellow with pale-yellow pubescence and pile in the usual regions, that of the abdominal dorsum most dense at the posterior margins of the segments. Halteres yellow. Wings infuscated as follows: Cells R, 2d M and 1st A except at their extreme bases and a small round hyaline spot in cell 2d M at the bifurcation of vein M, also the apical portion of cell 1st A is more or less hyaline along vein 2d A; cell R_1 apically from the yellow stigma; cells R_3 and R_4 entirely, except for a subhyaline area along the apical portion of the latter; the proximal half of cell R_5 (in this cell the color is solid up to the bifurcation of veins M_1 and M_2, from which it extends across to the bifurcation of vein R_{4+5}, thence tapering along vein R_5); the proximal third of cell 1st M_2; the extreme base of cell M_3; the basal portion of cell Cu_1 and tapering along vein Cu_2. Legs pale yellow; apical tarsal segments darker. Male: Antennae yellow with long black hairs on the two basal segments; palpi and proboscis brown, the former with long black hairs; genae and frontoclypeus fulvous brown pollinose with fulvous pile. Dorsum of thorax and scutellum fuscous with sparse pale-yellow pubescence and long dark pile, the former with two faint pale stripes most apparent anteriorly; pleurae and venter gray-brown pruinose with pale yellow and some black pile. Dorsum of abdomen fuscous with black pubescence, the hind margins of the segments yellow with yellow pubescence. Venter light brown with yellow pubescence, the apical segments somewhat darker on their discs. Halteres yellow. Wings like the female except that the infuscation is darker and the costal cell is yellow except at the base. Legs yellow; the apical two segments of the front and hind tarsi, fuscous.

Remarks. This most interesting species (the only one of its genus) is so well known and so distinct that it need be discussed no further within the scope of this paper. Schwardt (1934) has contributed valuable information on the biology and habits of *G. chrysocoma.*

Type Data. I have seen the type female in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. It is somewhat faded, but otherwise in excellent condition. Osten Sacken gives as the habitat the Middle States; Trenton Falls, New York and Delaware. According to the author a type male is in the Museum of the Entomological Society of Philadelphia.

Distributional Data:

UNITED STATES: New York 1, Aug. 9; Maryland 2, May 29, July 14; Pennsylvania 5, June 3-27; Virginia 3, June 19 - July; West Virginia 1, Aug. 11; Ohio 5, June 13 - July 24; Arkansas 1, May 19-22 (reared).

In addition, reported by others from:

UNITED STATES: New Jersey, Delaware, District of Columbia.

Apatolestes Williston (1885)

1885. *Apatolestes* Williston, Entom. Amer., I, 12.

Generic Characters. Eyes hairy or bare, contiguous in the male, broadly separated in the female. Ocelli present. Vertex broad. Flagellum of antennae eight-segmented. Palpi stout, dorsally grooved. Proboscis shorter than the head, scarcely longer than the palpi. Wings with a stump at the bifurcation of vein R_{4+5}.

Genotype. Apatolestes comastes Williston (1885).

Remarks. With the possible exception of *A. comastes,* all species of this genus appear to be confined to California.

KEY TO SPECIES

1. Eyes hairy (Comops)..*hera* (O. S.), p. 375
Eyes bare (Apatolestes).. 2
2. Pile of head thorax and front coxae black, with some fulvous intermixed; palpi dark 3
Pile of head, thorax and front coxae white; palpi light........................ 4

3. Shining black species; vertex shining black inflated above antennae like a frontal callus; abdominal tergite without light hind margins..............*ater* n. sp., p. 371
Dull black species; vertex not shining fulvous pollinose about the edges, no callus-like area; abdominal tergites with gray hind margins............*hinei* n. sp., p. 374
4. Vertex shining black, inflated above antennae like a frontal callus; length not exceeding 11 mm... 5
Vertex not shining black, no callus-like area; length about 14 mm.............. 6
5. Antennae yellowish, apex of flagellum black, palpi with pale pubescence; costal cell of wing hyaline.......................................*comastes* Will., p. 372
Antennae black, palpi with black pubescence; costal cell of wing yellow.
comastes willistoni n. var., p. 373
6. Palpi tenuous at apex, brown species.........................*albipilosus* n. sp., p. 371
Palpi not tenuous at apex, gray brown species.....................*similis* n. sp., p. 374

Subgenus *Apatolestes* s. str.

Under this group I am placing all species with eyes bare.

Apatolestes (*Apatolestes*) *albipilosus*, new species

Color. Light brown with some gray pruinosity; wings lightly fumose, most saturate at the costal margin and along the veins.

Size. Length, 14 mm.

Structural and Color Characters. Female: Vertex light brown with some yellow pollen; genae and frontoclypeus grayish-yellow pollinose with little black and much whitish pile. Antennae yellow except the black at the apex of the flagellum. Palpi yellow with black pubescence. Thorax and scutellum light brown with a gray pruinosity, the former with obscure stripes on the dorsum. Abdomen light brown, gray pruinose, with light-gray posterior margins on all segments. Wings pale fumose, most saturate at the costal area and along the veins; an appendage at the bifurcation of vein R_{4+5}. Legs light brown with intermixed black and whitish pubescence; the front coxae with white pile.

Comparative Notes. Separated from *A. hinei* n. sp. as indicated under that description.

Type Data. Holotype, female; Lemon Cove, California; July 26, 1929; R. H. Beamer. In the Francis Huntington Snow Entomological Collection of the University of Kansas. One female San Joaquin river near Fresno, California, August 15, 1922. (U. S. N. M.)

Apatolestes (*Apatolestes*) *ater*, new species

Color. Shining black.

Size. Length, 13 mm.

Structural and Color Characters. Female: Vertex shining black with traces of gray pollen, the anterior vertex inflated, thus forming a broad quadrate area similar to a frontal callus. Ocelli white. Frontoclypeus and genae grayish pollinose with brown-gray pile. Antennae black, scape and pedicel gray pollinose with black pubescence. Palpi appear black, although the ground color is somewhat reddish, with dense black pubescence. Thorax and scutellum black, the former with faint streaks of gray on the dorsum; pleurae with blackish pile. Abdomen black, the posterior margins of the segments scarcely differentiated as to color. Wings fumose, costal cell and stigma brown; an appendage at the bifurcation of vein R_{4+5}. Legs black. Male: Similar to the female except for sex characters. Frontal triangle fulvous pruinose. The large facets occupy the upper three fourths of the eyes.

Comparative Notes. The shining black appearance of *A. ater* should be sufficient to separate it from the other species of Apatolestes. The vertex resembles that of *A. comastes* Will., but the dark pile of the facial regions is distinctive, as well as its larger size. The male is readily separated from that of *A. hinei* n. sp. by the abdominal tergites, which lack pale hind margins.

Type Data. Holotype, female; San Diego, California; July 7, 1929; Paul W. Oman. Allotype, male; Claremont, California. Paratype, one female; same data. Holotype and paratype in the Francis Huntington Snow Entomological Collection of the University of Kansas. Allotype in the Ohio State Museum, Columbus, Ohio.

Apatolestes (Apatolestes) comastes Williston (1885)

(Plate XXIX, fig. 11; Plate XXXV, fig. 76)

1885. *A. comastes* Williston, Entom. Amer., I, 12.
?1895. *A. comastes* Townsend, Proc. Cal. Acad. Sci., IV, 596.
1904. *A. comastes* Hine, Ohio Nat., V, 230.
1923. *A. comastes* Cole, Proc. Cal. Acad. Sci., XII, 458.

Color. Gray-black.

Size. Length, 8 mm. to 11 mm.

Structural and Color Characters. Female: Vertex shining black, slightly inflated anteriorly, much like a frontal callus; frontoclypeus and genae whitish pollinose with white and very little black pile intermixed; palpi yellowish with gray pruinosity and whitish pubescence; antennae yellowish-brown except the black apex of the flagellum. Dorsum of thorax and scutellum black, gray pruinose, the former with narrow faint gray stripes; pleurae and venter gray-black, pruinose, with white pile. Abdomen gray-black, pruinose, the segments with whitish hind margins. Halteres brown. Wings subhyaline; veins brown; a stump at the bifurcation of vein R_{4+5}. Legs light brown and black, the latter distributed as follows: Front and hind coxae and femora, front tarsi and sometimes the apex of the front tibiae, and a little on the middle femora. The front coxae are covered with grayish pollen and white pile. Male: Unknown.

Comparative Notes. The gray-black or bluish-gray color is characteristic for this species. This along with the white hind margins of the abdominal tergites and the shining black inflated anterior vertex permits ready separation. See, also, under descriptions of *A. ater* and *A. hinei,* new species.

Remarks. In the series of *A. comastes* which I have for study I find two distinct forms, one of which differs sufficiently from the type so that it deserves varietal rank. See under description of *A. comastes willistoni* n. var.

Type Data. Described from two females from California. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

Distributional Data:

UNITED STATES: California: Lemon Cove, July 26, 1929; Three Rivers, Aug. 1, 1929; Marin Co., Aug. 3, 1929; California, "Baron"; Los Angeles Co., July; Cloverdale, Oct. 6, 1915.

In addition, reported by others from:

UNITED STATES: Arizona.

Apatolestes (Apatolestes) comastes willistoni n. var.

Color. Gray-black.

Size. Length, 8 mm. to 11 mm.

Structural and Color Characters. Female: Similar to *A. comastes* Will. with the following differences: The costal cell of the wing is yellow; the antennae are wholly black, sometimes the scape and pedicel with some grayish pruinosity; palpi with black pubescence and a little white intermixed. The legs are predominantly black; basal half of front tibiae, basal three fourths of middle and hind tibiae, basal segments of middle and hind tarsi, light brown.

Type Data. Holotype, female: San Diego county, California; July 7, 1929; Paul W. Oman. Paratypes, eight females, San Jacinto Mts., California, July 21, 1929; R. H. Beamer, Paul W. Oman, and L. D. Anderson; eight females, San Diego county, California; R. H. Beamer, Paul W. Oman, and L. D. Anderson; two females, Big Bear Lake, California, July 26, 1932, J. D. Beamer; one female, Laguna Mts., California, July 6, 1929; R. H. Beamer.

Apatolestes (*Apatolestes*) *hinei,* new species

Color. Gray-brown; abdominal segments with pale posterior margins.

Size. Length, 12 mm. to 14 mm.

Structural and Color Characters. Female: Posterior vertex brown with a trace of gray-yellow pollen; anterior vertex, frons, frontoclypeus and genae pollinose, these last two with fulvous and black pile. Scape and pedicel reddish or yellowish with black hairs; flagellum black apically, at its base reddish. Palpi, concolorous with basal antennal segments, with long black pubescence. Dorsum of thorax, scutellum, pleurae and venter brown-gray pollinose; the first with obscure stripes of alternate gray and brown. Abdomen gray-brown with blackish pile; the posterior margins of all segments conspicuously pale yellow-gray with whitish pile. Wings fumose, subcostal cell, stigma and veins light brown; an appendage at the bifurcation of vein R_{4+5}. Legs brown with black hairs; anterior coxae, femora, and apical portions of tarsi nearly fuscous. Male: Like the female except for sex characters. More densely pilose about the head, thorax, and pleurae. The large facets, distinctly differentiated from the small ones, occupy about the upper three fourths of the eyes.

Comparative Notes. The general aspect of this species is that of a large *A. comastes* Will. However, the different color, large size, more fumose wings, absence of a shining black area on the anterior vertex, yellowish facial regions with fulvous pile, readily separate these two. *A. hinei* is more nearly related to *A. albipilosus,* but the latter exhibits a lighter brown color throughout. The pilosity of the head and thorax is mostly white and the front femora and coxae are concolorous with the remainder of the legs.

Type Data. Holotype female; San Jacinto Mts., July 21, 1929; R. H. Beamer. Allotype, male; same locality and date; Paul W. Oman. Paratypes, two males, same data as holotype and allotype, respectively; three females, same data; one female, Alpine, California, July 9, 1929; Paul W. Oman. In the Francis Huntington Snow Entomological Collection, of the University of Kansas.

Apatolestes (*Apatolestes*) *similis,* new species

Color. Gray.

Size. Length, 14 mm.

Structural and color characters. Female: Vertex (except a broad, denuded brown mid-streak), genae and frontoclypeus, gray-white pollinose; the genae and postgenae with white and a little black pile. Palpi gray-yellow, with black and white hairs. Flagellum of antenna black; scape and pedicel gray-yellow with black and white hairs. Dorsum of thorax and scutellum black, gray pruinose, white pubescent, the former with faint stripes; pleurae and venter gray pruinose with white pile and on the humeri some black. Abdomen gray pollinose with black and white pubescence, the former dominant along the sides and apex, and discs of tergites, the latter conspicuous on the whitish hind margins of the segments; a ferruginous ground color shows through the pruinosity on the venter, near the base. Halteres yellow-brown. Wings subhyaline. Legs red-brown, darker basally and apically. Male: Like the female and easily associated.

Comparative Notes. Except for color this species has the habitus of *A. albipilosus* n. sp., but in that species the costal cells of the wings are yellowish and the palpi are more tenuous apically.

Type Data. Holotype, female, Los Angeles Co., California, July. Allotype, male, same data. In the United States National Museum.

Subgenus *Comops,* new subgenus

I am erecting this subgenus to receive the species *A. hera* (O.S.), at present the only one known with hairy eyes.

Apatolestes (*Comops*) *hera* (Osten Sacken) (1877)

1877. *Pangonia hera* Osten Sacken, West. Dipt., 214.
1904. *P. hera* Hine, Ohio Nat., V, 227.
1921. *Diatomineura hera* Surcouf, Gen. Ins., CLXXV, 130.
1925. *Apatolestes hera* Parker, Proc. Ent. Soc. Wash., XXVII, 195.

Color. Gray-brown, wings fumose.

Size. Length, 11 mm. to 14 mm.

Structural and Color Characters. Female: Vertex brown, anteriorly and laterally grayish pollinose, otherwise denuded; frontoclypeus and genae gray pollinose with whitish pile; palpi gray pruinose with white pubescence; scape and pedicel of antennae reddish or brown-yellow, flagellum black except for a minute reddish portion at the base. Thorax gray-brown, whitish pilose. Abdomen concolorous with thorax, whitish pilose, the segments with narrow pale hind margins. Wings fumose; a stump at bifurcation of vein R_{4+5}. Legs red-brown, darker basally and apically; the coxae and femora with white pile. Male: Similar to female except for sex characters. The dense pile about the head and thorax appears to have a tinge of yellow.

Comparative Notes. Easily distinguished from all other Apatolestes by the hairy eyes.

Remarks. According to recent writers, this species because of its hairy eyes would not be an Apatolestes. In both Enderlein's (1925) and Kröber's (1932) keys *A. hera* runs unsatisfactorily to either Osca Walker or Protodasyapha Enderlein. Both of these genera appear to be confined to western South America. Bequaert (1930) makes Osca a synonym of Scaptia Walker (the latter having page priority), but it is impossible to run *A. hera* in his key to Ethiopian Tabanidae to Scaptia, neither does it conform to notes or figures of Australian Scaptia. See Ferguson (1926). Also, this species does not compare favorably with the genotypes of Scaptia or Osca (*S. aurata* Macq. and *O. lata* Guer.) or with Enderlein's description of Protodasyapha. The sole character by which *A. hera* differs from the genotype of Apatolestes (*A. comastes* Will.) and all other species of the genus is the pilosity of the eyes. In the case of this group I doubt the generic value of such a character, but feel that it is of sufficient importance to give it subgeneric rank.

Type Data. Described from one female. In the Museum of Comparative Zoölogy, Cambridge, Massachusetts. I have studied this specimen. Osten Sacken (1877) states, "Habitat—San Francisco, California, caught in the street twice, by Mr. Henry Edwards in July. I have a single female."

Distributional Data:

UNITED STATES: California: Los Angeles Co., July; Pasadena, June 8, 1895. San Francisco, July 19-22, 1925.

Bequaertomyia, new genus

Generic Characters. Hind tibiae with apical spurs; vein 2d A sinuous, all marginal cells open; eyes densely pubescent in both sexes; ocelli present; vertex of the female broad; flagellum of the antenna eight-segmented; frontoclypeus very prominent; proboscis much shorter than the head; palpi short, arcuate, pointed. The abdominal segments of the female caudad from V are narrowed and laterally compressed, when completely exserted appear to be modified for oviposition.

Comparative Notes. The sinuous anal vein would place this genus in the subfamily Coenomyiinae of Bequaert (1930), but until further study gives more evidence to the contrary, I prefer to include all North American genera of Tabanidae with apical spurs on the hind tibiae in the subfamily Pangoniinae. Bequaertomyia has no close relatives in North America; however, its general aspect would indicate affinities with the Chilean genus Coenura Bigot, from which it differs in the pubescence of the eyes and the palpi which are pointed at the ends and not scooped out. Coenomyia Latreille (not included in this paper for want of material and evidence) is the only other genus north of Mexico which Bequaert has assigned to his Coenomyiinae, but it is not sufficiently close to Bequaertomyia to necessitate calling attention to its distinctness.

Named in honor of Dr. J. Bequaert, who has contributed evidence to show that this genus and the genera Coenomyia Latreille, Coenura Bigot, and Pelecorhynchus MacQuart form a transitional group between the Leptidae and Tabanidae.

I hereby designate the following species *Bequaertomyia anthracina*, new species, as the genotype.

Bequaertomyia anthracina, new species

(Plate XXIX, figs. 5, 7, 9, 12; Plate XXXV, fig. 83)

Color. Coal black, wings fumose, antennae and palpi orange.

Size. Length, 13 mm. to 15 mm.; length of wing, 12 mm. to 13 mm.; width of vertex barely 1 mm.

Structural and Color Characters. Female: Dense black pilose. Head scarcely as broad as the thorax. Eyes pubescent, broadly separated by the vertex. Antennae orange; the scape and pedicel of equal length, together about as long as the first segment of the flagellum. Vertex with a slightly convex shining black quadrate callus-like area, broader than long. Posterior vertex somewhat hollow; ocelli yellowish, mounted on a high gray-pollinose tubercle. Frontoclypeus shining black, prominent, globose, somewhat covered by gray pollen near the oral margin. Frons and genae gray pollinose. Proboscis very short, about one half the length of the head; labellae large and fleshy. Palpi short, arcuate, pointed; orange with long black pile. The black of the dorsum of the thorax with dark-gray pollen; the distinctly projecting humeral callus orange. Scutellum, pleural and sternal regions shining black. Halteres orange. Abdomen broad at base, shining black. Wings fumose with a yellowish tinge at the base, most saturate along the costal area and in cells R and R_1; veins light brown to orange. Legs black, the usual basal portions of the tibiae and tarsi lighter, nearly a dull red-brown, especially noticeable in the posterior tibiae. Male: Like the female except for the usual sex characters. The eyes are contiguous, the pubescence and pile longer and more dense, producing a shaggy appearance. Abdomen gradually tapering from its base.

Type Data. Holotype: Female, Giant Forest, California; July 28, 1929; R. H. Beamer. Allotype: Male, Signal Park, Washington; July 4, 1930. Paratypes: Three females, Giant Forest, California; July 28, 1929; R. H. Beamer, L. D. Anderson, and Paul W. Oman, respectively. In the Francis Huntington Snow Entomological Collection of the University of Kansas.

Species reported from North America north of Mexico not included within this paper because of insufficient or no evidence for identification:

Chrysops cincticornis Walker (1848) List, I, 201; N. A.?

Chrysops sepulcralis (Fabricius) (1794) Ent. Syst. IV; Europe.

Pangonia macroglossa Westwood (1835) Lond. and Edinb. Philos. Mag., ser. 3, VI; Ga.

Corizoneura velutina Bigot (1892) Mem. Soc. Zoöl. France, V, 615; Calif.

Ricardoa latiflagrum Enderlein (1925) Mitt. Mus. Berlin, XI, 291; Texas. [May be *E. incisuralis* (Say).]

ADDENDA

Chrysops lapponica Loew (1858) Zoöl.-bot. Ges. Wien., VIII, 624.

This North European species is apparently represented in our fauna. There is one female, Shippigan, N. B., July 14, 1931, J. M. Aldrich, in the United States National Museum which compares quite favorably with European specimens. The black of the antennae, palpi, legs and body is more extensive. The wing picture is similar except for a broader apical spot. The abdominal pattern somewhat resembles *C. nigripes* Zetterstedt.

I am aware that this is scant evidence to show that *C. lapponica* is nearctic as well as palaearctic, but at the time of writing no other course presents itself.

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PLATE XXIX

FIG. 1. *Esenbeckia incisuralis* (Say) female, anterior view of head.

FIG. 2. *Chrysops beameri* n. sp. female, anterior view of head. Typical for a large group in which the vertex is longer than broad.

FIG. 3. *Stonemyia* (*Pilimas*) *californica* (Bigot) female, anterior view of head. Drawn from type of *Pangonia dives* Williston.

FIG. 4. *Chrysops latifrons* n. sp. female, anterior view of head. Typical for small western group in which the vertex is as broad as, or broader than long.

FIG. 5. *Bequaertomyia anthracina* n. g., n. sp., section of wing showing vein 2d A sinuous.

FIG. 6. *Chrysops brunnea* Hine male, anterior view of head showing eyes contiguous.

FIG. 7. *Bequaertomyia anthracina* n. g., n. sp. female, dorsal aspect of abdomen with caudal segments exserted.

FIG. 8. *Chrysops clavicornis* n. sp. male, anterior view of head showing eyes closely approximated, but distinctly separate. Typical of small western group.

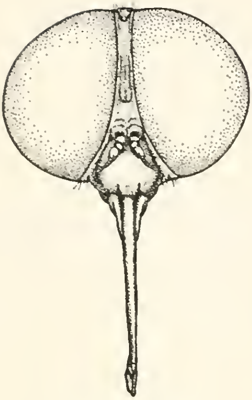
FIG. 9. *Bequaertomyia anthracina* n. g., n. sp. female, lateral aspect of head.

FIG. 10. *Goniops chrysocoma* (Osten Sacken) female, anterior view of head.

FIG. 11. *Apatolestes comastes* Williston female, anterior view of head. Drawn from type.

FIG. 12. *Bequaertomyia anthracina* n. g., n. sp. female, anterior view of head.

PLATE XXIX



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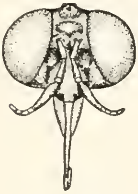

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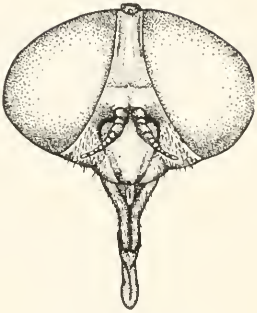

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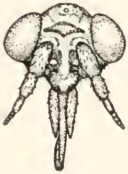

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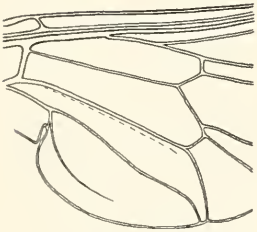

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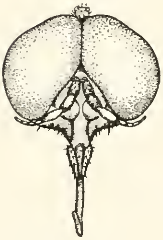

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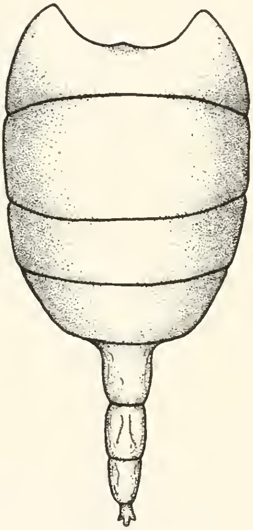

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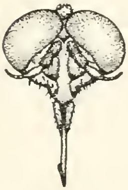
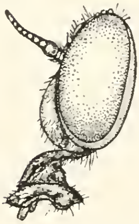


8 C. CLAVICORNIS



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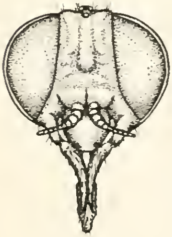

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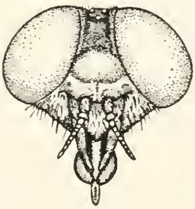

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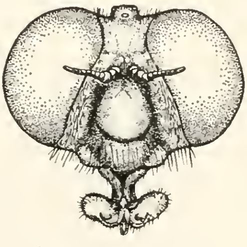
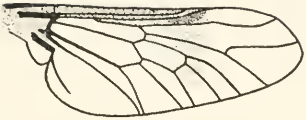


12 B. ANTHRACINA

PLATE XXX

FIGS. 13 to 24. Wing pictures of typical female Chrysops.

PLATE XXX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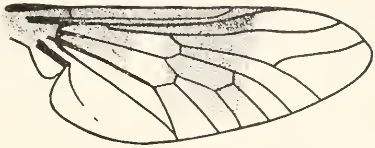
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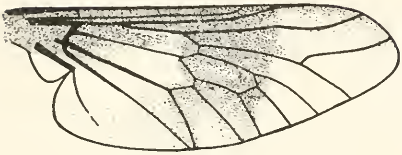
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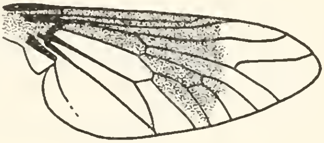
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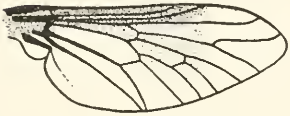
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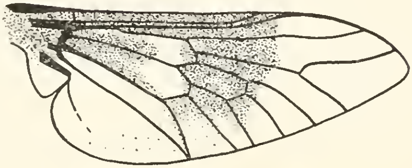
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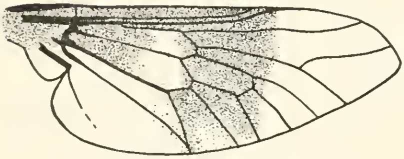
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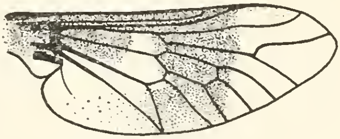
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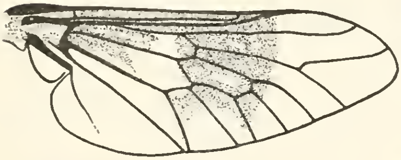
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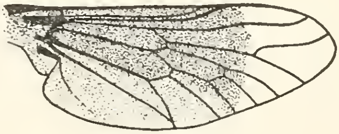
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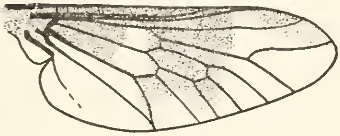
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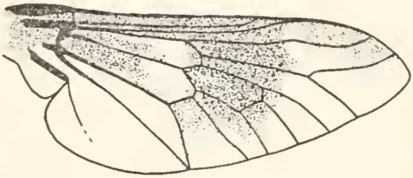
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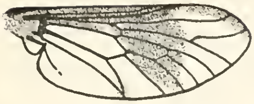
PLATE XXXI

Figs. 25 to 37. Wing pictures of typical female Chrysops.

PLATE XXXI



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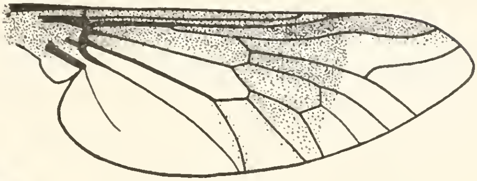

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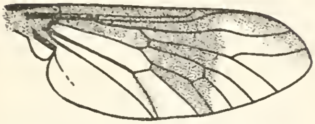

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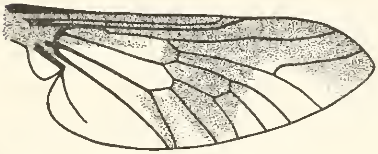

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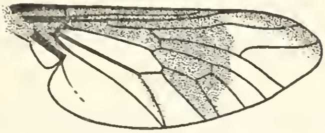

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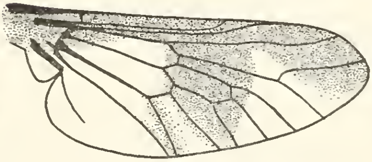

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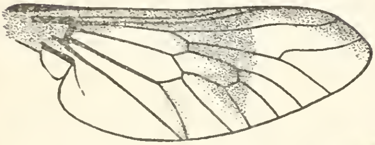

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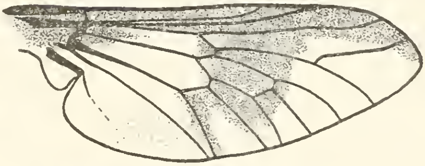

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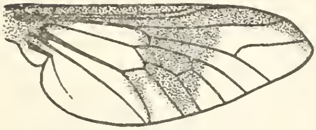

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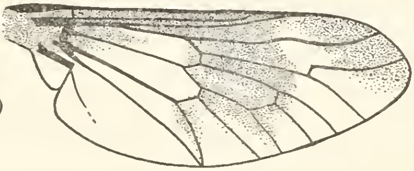

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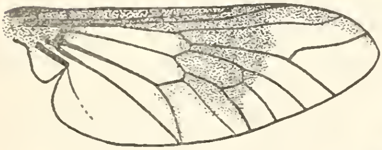

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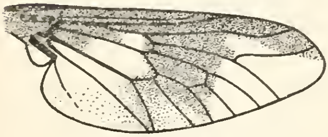

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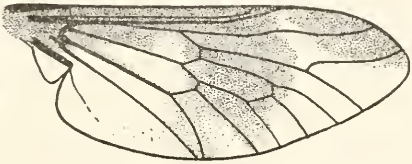
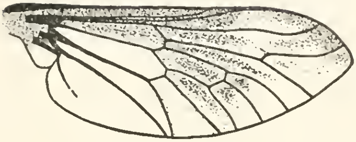


37 FURCATA

PLATE XXXII

Figs. 38 to 49. Wing pictures of typical female Chrysops.

PLATE XXXII



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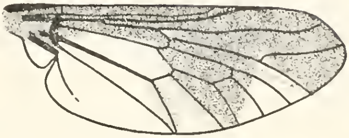

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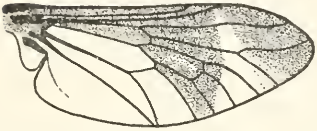

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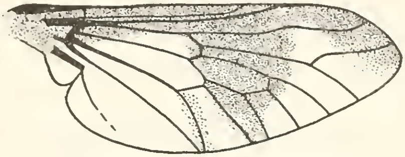

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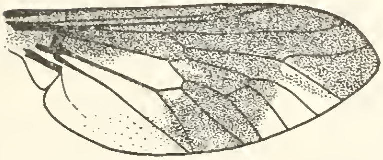
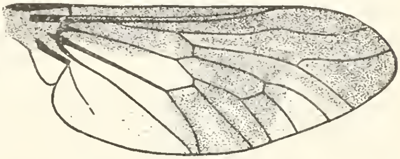
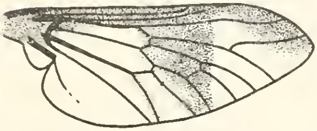


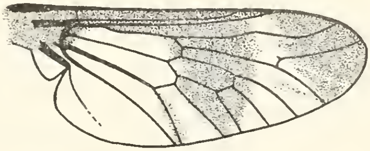
42 VITTATA



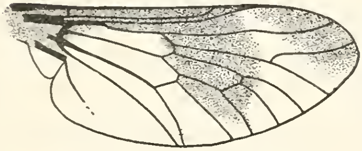
43 VITTATA FLORIDANA



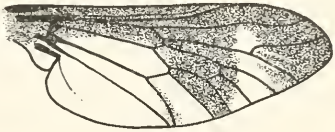
44 CURSIM



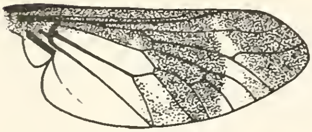
45 GEMINATA



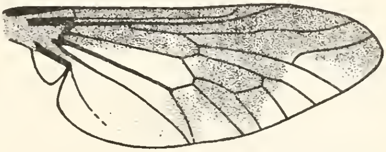
46 LATERALIS



47 PIKEI



48 SEQUAX

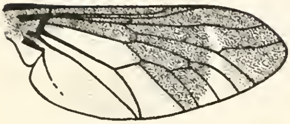


49 INDA

PLATE XXXIII

FIGS. 50 to 63. Wing pictures of typical female Chrysops. Figures 50, 52 and 58 from the types.

PLATE XXXIII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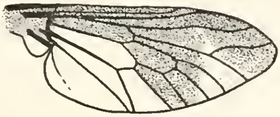
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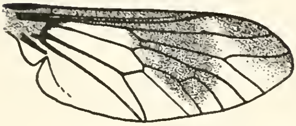
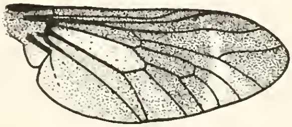
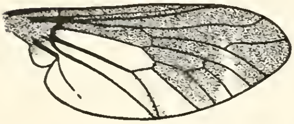
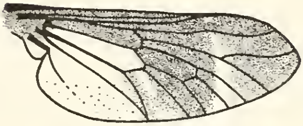
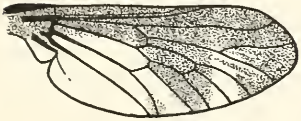

52 WIEDEMANNI


53 ULTIMA


54 LUGENS


55 HINEI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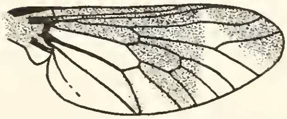
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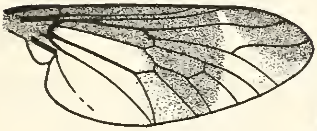
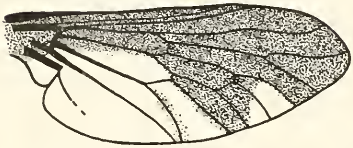

58 SEPARATA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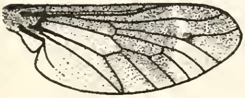
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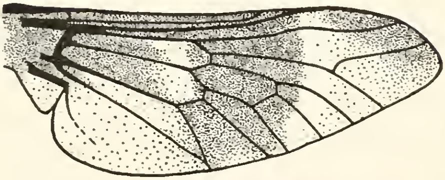
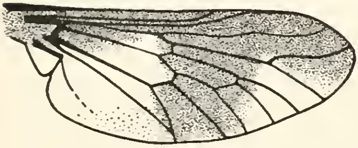

61 AMAZON


62 FRIGIDA

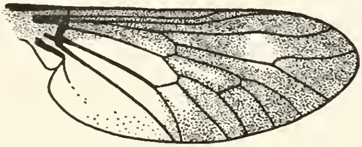
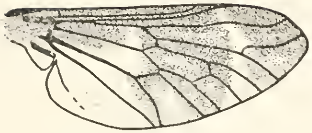

63 BISTELLATA

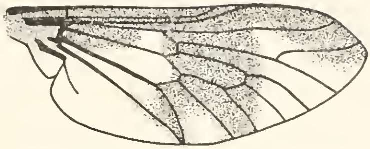
PLATE XXXIV

Figs. 64 to 75. Wing pictures of typical female Chrysops.

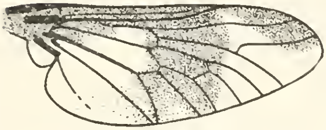
PLATE XXXIV



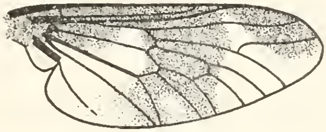
64 CLAVICORNIS



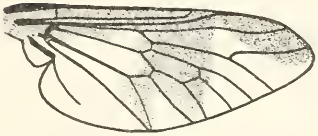
65 COQUILLETTI



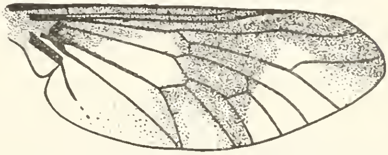
66 FACIALIS



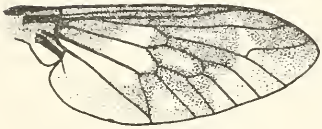
67 ROBUSTA



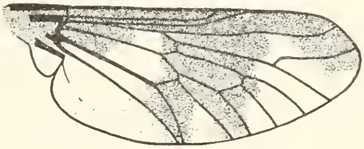
68 PACHYCERA



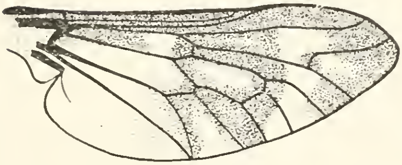
69 FLAVIDA



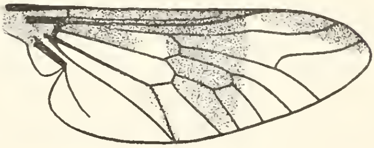
70 FULVASTRA



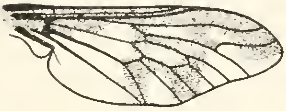
71 VIRGULATA



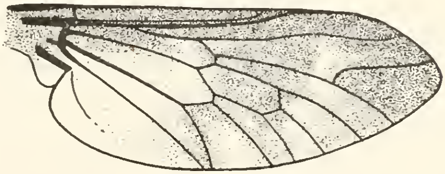
72 DISCALIS



73 DISSIMILIS



74 LATIFRONS

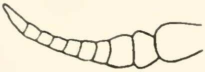


75 BRUNNEA

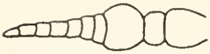
PLATE XXXV

Figs. 76 to 93. Lateral aspects of antennae characteristic of neartic Pangoniinae.

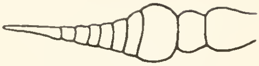
PLATE XXXV



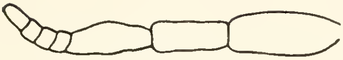
76 A COMASTES



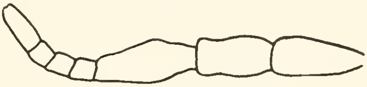
77 G. CHRYSOCOMA



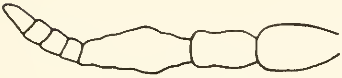
78 E. INCISURALIS



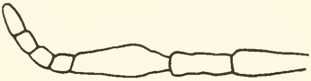
79 C. DISSIMILIS



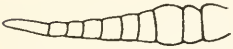
80 C FLAVIDA



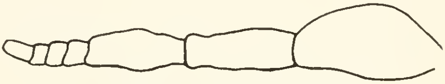
81 C. BRUNNEA



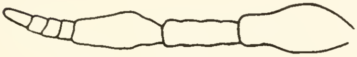
82 C. VITTATA



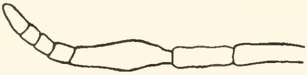
83 B. ANTHRACINA



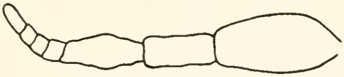
84 C COQUILLETTI



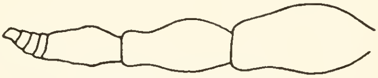
85 C. CLAVICORNIS



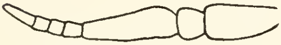
86 C. BEAMERI



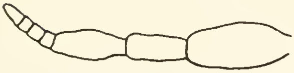
87 C ROBUSTA



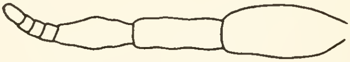
88 C. VIRGULATA



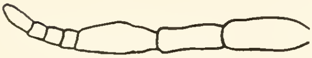
89 S GIGANTULUS



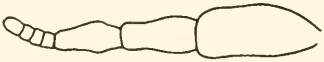
90 C. FULVASTRA



91 C. PACHYCERA



92 C. FACIALIS



93 C. LATIFRONS

PLATE XXXVI

FIG. 94. *Stonemyia* (*Stonemyia*) *tranquilla* (Osten Sacken) female, anterior aspect of head. V = vertex.

FIG. 95. *Silvius laticallus* n. sp. female, anterior aspect of head.

FIG. 96. *Buplex suavis* (Loew) female, anterior aspect of head.

FIG. 97. *Stonemyia tranquilla* (Osten Sacken) female, lateral view of palpus.

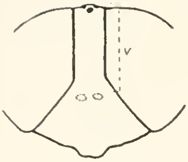
FIG. 98. *Silvius sayi* n. sp. female, anterior aspect of head.

FIG. 99. *Buplex suavis* (Loew) female, lateral aspect of palpus.

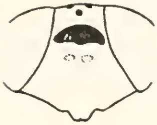
FIG. 100. *Chrysops hungerfordi* n. sp. female wing picture.

FIGS. 101 to 104. Wing pictures of typical female Silvius.

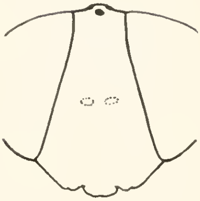
PLATE XXXVI



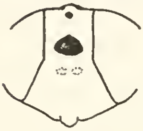
94 S TRANQUILLA



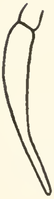
95 S. LATICALLUS



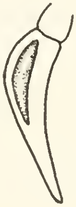
96 B. SUAVIS



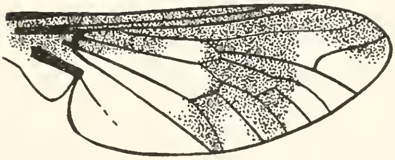
98 S SAYI



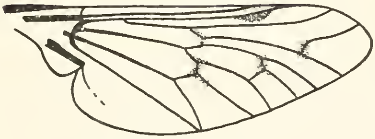
97 S TRANQUILLA



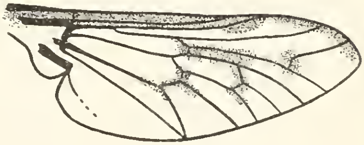
99 B SUAVIS



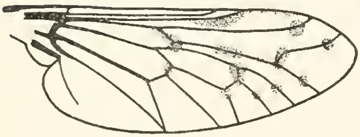
100 C HUNGERFORDI



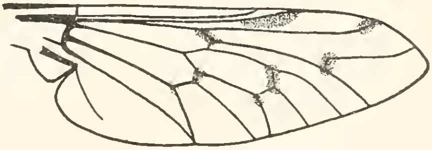
101 S. LATICALLUS



102 S SAYI



103 S. QUADRIVITTATUS

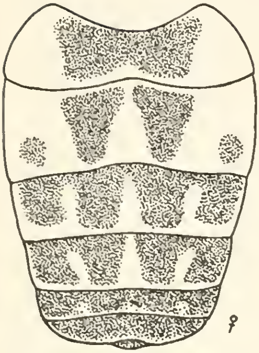


104 S POLLINOSUS

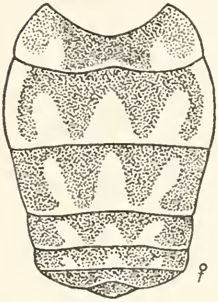
PLATE XXXVII

FIGS. 105 to 114. Dorsal abdominal patterns of new and related or misinterpreted Chrysops.

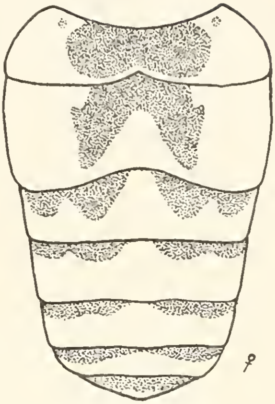
PLATE XXXVII



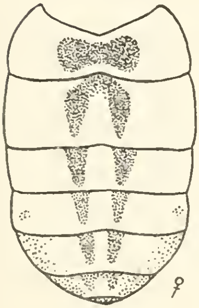
105 CLAVICORNIS



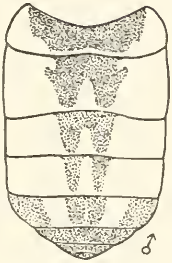
106 ROBUSTA



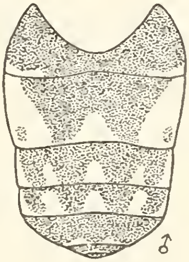
107 BISHOPPI



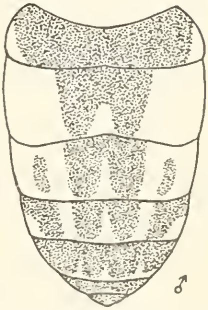
108 PACHYCERA



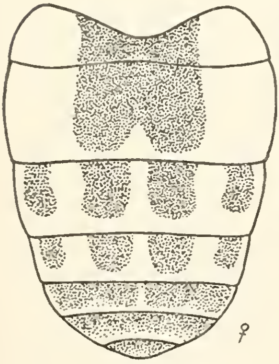
109 PACHYCERA



110 CLAVICORNIS



111 COQUILLETTI



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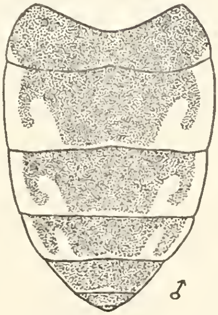

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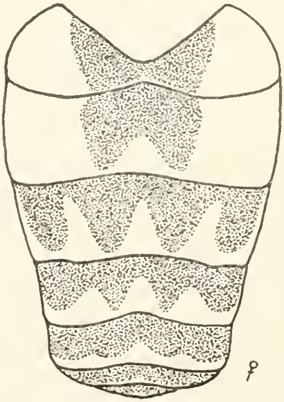

114 FURCATA

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The Genus Tenagobia Bergroth (Corixidae, Hemiptera)

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ABSTRACT: The genus TENAGOBIA is confined to the New World. Sixteen species are recognized in this paper. The following nomenclatorial changes are recognized: *T. socialis sobrina* (White) syn. of *T. signata* (White); *T. seducta* (White) syn. of *T. signata* (White); *T. simulans* (White) syn. of *T. signata* (White); *T. signata incerta* Lundblad raised to specific rank; *T. minuta* Deay syn. of *T. costaricana* Jaczewski.

A key to the four genera in the subfamily MICRONECTINAE is given and another for the species of the genus TENAGOBIA. The taxonomic relationships morphology and geographical distribution are discussed. The study is based upon 11,000 specimens.

INTRODUCTION

THE genus TENAGOBIA Bergroth, which includes those small, new-world corixids which are characterized by having an exposed scutellum and a crescent-shaped pronotum, has been much neglected by systematic workers. Nothing or little of the morphology and distribution of the species has been published, and no key for the separation of the species exists. Most of the few papers dealing with the members of this genus are but isolated descriptions of new species, and no attempt to deal with the genus as a whole has been made.

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[1] Contribution of the Department of Entomology, University of Kansas.

In the present paper the writer purposes to give a complete treatment of the present knowledge of the relationships, morphology, synonymy and distribution of the members of the genus, together with a detailed discussion of the species and a key for separating them. The manuscript has been completed up to July 1, 1934.

The writer wishes to express his appreciation to all who have assisted him in the preparation of this paper. He is especially indebted to Dr. H. B. Hungerford of the University of Kansas, at whose suggestion and under whose direction this work has been performed. Most of the material used in this study has been accumulated by Doctor Hungerford and, furthermore, he examined material, especially the types of Lundblad's and Stål's species, in European museums and private collections which were inaccessible to the writer. The writer also wishes to express his thanks to the following: Dr. O. Lundblad, Naturhistoriska Riksmuseum, Stockholm, Sweden, who generously and promptly answered all questions concerning his species; Dr. W. E. China, who has sent the writer cotypes of the Buchanan-White species, the specimens of Tenagobia collected by Champion, Smith and Forrer, and much other material from the British Museum for examination and study; Dr. E. Wagner of the Zoologische Staatsinstitut und Zoologische Museum, Hamburg, who loaned the writer the holotype of *T. costaricana* Jaczewski, 1930, and other material for study; Dr. A. Dampf, chief entomologist of Mexico, who has sent the writer much material and data; and the curator of the United States National Museum, who loaned the writer the Tenagobia material deposited there which was collected by H. H. Smith in Grenada.

A HISTORICAL SKETCH OF THE GENUS AND A REVIEW OF THE LITERATURE

The genus Tenagobia was erected by E. Bergroth (1)[2] in 1889 for his new species, *marmorata,* which was taken in Venezuela. He bases the genus upon the crescent-shaped pronotum which distinguishes it from the closely related old-world genus Micronecta Kirkaldy. He also mentioned that *Sigara fuscata* Stål, 1859, and the five South American species of Sigara described by Buchanan-White (29) in 1879 belonged to this new genus.

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[2] Numbers in parentheses refer to literature cited.

The first species of Tenagobia that were described, those of Stål and White, were assigned to the genus Sigara of authors (*nec* Fabricius, 1775), a genus to which all "water boatmen" with a visible scutellum were referred until Kirkaldy (14) erected the genus Micronecta in 1897 to accommodate these species. Therefore, Stål's and White's species of the present genus Tenagobia were included in the genus Micronecta, although Kirkaldy did not mention them specifically.

T. fuscata (Stål, 1859) is the first species of Tenagobia that was described. It was collected by Hj. Kinberg in Montevideo while with the Swedish frigate "Eugenie" on its circumnavigation of the globe from 1851 to 1853. Stål (25) as a matter of course placed his species in the genus Sigara.

F. Buchanan-White (29) in 1879 described five new species and a new variety of the genus from material collected by the Traill Expedition to Brazil in 1873-'75. White's species are *T. selecta, T. signata, T. socialis, T. seducta* and *T. simulans,* and the variety, *T. socialis* var. *sobrina.* Of these, *T. signata, T. seducta, T. simulans* and *T. socialis* var. *sobrina* have proved to be identical. He also identified some of the specimens as *T. fuscata,* which is probably an erroneous identification. Although White placed his species in the genus Sigara, he pointed out the fact that these new-world species had a crescent-shaped pronotum, the character which was later used by Bergroth for his generic criterion.

In 1894 P. R. Uhler (26) reported *T. socialis* from Grenada, Lesser Antilles, and stated that this species also occurred in Mexico and California. The Grenada specimens which Uhler referred to *T. socialis* are *T. incerta* Lundblad, 1928. The writer has been unable to locate any specimens of Tenagobia that have been collected in California and has found no other references in the literature to this northern distribution except those based on the above assertion. In all probability the specimens which Uhler saw from California and Mexico are *T. mexicana* Deay, 1930.

The next mention of this genus in the literature, aside from the proposal of the generic name by Bergroth and the description of *T. marmorata* which have already been mentioned, was by G. C. Champion in "Biologia Centrali-Americana" in 1901. In this he reported that specimens of *T. socialis* had been taken in Mexico, Guatemala and Panama, and published for the first time an illustration of a member of this genus. The writer has examined all of the specimens to which Champion refers and has found them to be *T. mexicana* instead of *T. socialis.*

Although Kirkaldy (15), Kirkaldy and Bueno (16) and Van Duzee (27) mention the genus in their check lists and catalogues, no further contributions were made to the knowledge of the genus until 1927 when H. B. Hungerford (9) described a new species, *T. pulchra,* which had been collected by the Mulford Biological Expedition to Bolivia in 1921-'22, and reported *T. selecta* from Bolivia. He is the first to use the claspers of the male for specific characters. He published illustrations of the claspers, abdomen and fore tarsus of both *T. pulchra* and *T. selecta* and pointed out that the latter species is pterodimorphic.

In 1928 T. Jaczewski (10) in his paper on the distribution of the Corixidae discusses Tenagobia briefly as to its relationships and probable distribution.

In the same year O. Lundblad (17) described three new species and a new variety of the genus. These are *T. melini,* and *T. romani* from Manoas, Brazil, and *T. schadei* and *T. signata* var. *incerta* from Paraguay. He redescribed *T. fuscata, T. selecta* and *T. signata;* made *T. socialis* var. *sobrina, T. seducta* and *T. simulans* synonyms of *T. signata;* and reduced *T. socialis* to a variety of that species. In his generic description Lundblad pointed out that the absence of a strigil in the members of this genus is an important generic criterion.

A second paper by Jaczewski (11) in which Tenagobia is mentioned appeared in 1930. In this paper he described a new species, *T. costaricana,* from Costa Rica and recorded *T. signata* from Mexico and Dutch Guiana, and *T. fuscata* from Argentina (Buenos Aires) and Uruguay (Montevideo). His identification of *T. signata,* however, is erroneous; the writer has examined the specimens which he identified and found the one from Mexico to be *T. mexicana* and the ones from Guiana to be *T. socialis.*

In 1930 Deay (3) described six species of the genus as new to science: *T. minuta* from Panama, *T. truncata* and *T. constricta* from Ecuador, *T. mexicana* from Mexico, *T. serrata* from Bolivia, and *T. hungerfordi* from Matto Grosso, Brazil. Of these species *T. minuta* is identical with *T. costaricana* Jaczewski, and is a synonym of that species since Jaczewski published in May, 1930, and Deay in June, 1930.

Jaczewski (12) in 1931 lists *T. signata, T. socialis* and *T. mexicana* as having been reported from Mexico. As pointed out above these records all refer to *T. mexicana.*

The most recent mention of the genus in the literature is in a paper by Jaczewski (13) published May, 1933, in which he records *T. incerta* and *T. schadei* from Pernambuco (Recife), Brazil.

LIST OF SPECIES AND SYNONYMS WITH TYPE LOCALITIES

1. *T. fuscata* (Stål, 1859), Montevideo, Uruguay.
2. *T. selecta* (White, 1879), Manaos, Brazil.
3. *T. signata* (White, 1879), Rio Purus, Brazil.
4. *T. socialis* (White, 1879), Rio Maderia up to Sao Antonio da Boa Vista; Anana, Upper Amazon; Urubu Caxoeira, Rio Jurua; Rio Trombetas; Manaos, Brazil.
5. *T. socialis* var. *sobrina* (White, 1879), Urucaca, Rio Jurua, Brazil. A synonym of *T. signata*.
6. *T. seducta* (White, 1879), Rio Jurua, Brazil. A synonym of *T. signata*.
7. *T. simulans* (White, 1879), Upper Amazon and Tonantins, Brazil. A synonym of *T. signata*.
8. *T. marmorata* Bergroth, 1899, Venezuela.
9. *T. pulchra* Hungerford, 1927, Rio Beni, Bolivia.
10. *T. signata* var. *incerta* Lundblad, 1928, Villa Rica, Paraguay. Raised to specific rank in this paper.
11. *T. melini* Lundblad, 1928, Manaos, Brazil.
12. *T. schadei* Lundblad, 1928, Villa Rica, Paraguay.
13. *T. romani* Lundblad, 1928, Manoas, Brazil.
14. *T. costaricana* Jaczewski, 1930, Reventazon river, Costa Rica.
15. *T. minuta* Deay, 1930, Boqueron river, Panama. A synonym of *T. costaricana*.
16. *T. truncata* Deay, 1930, Tena, Ecuador.
17. *T. mexicana* Deay, 1930, Nainari, Sonora, Mexico.
18. *T. serrata* Deay, 1930, Lower Mamore river, Bolivia.
19. *T. constricta* Deay, 1930, Tena, Ecuador.
20. *T. hungerfordi* Deay, 1930, Corumba, Matto Grosso, Brazil.

SYNONYMY

After a careful examination of the cotypes of *T. signata*, *T. socialis* var. *sobrina*, and *T. seducta* (B. White), the writer has decided that they are one and the same species. Since *T. signata* has pagination priority over the others, *T. seducta* and *T. socialis* var. *sobrina* are synonyms of *T. signata*. White based his species upon color, and he, himself, was very doubtful of the specificity of *T. seducta*. He says in his notes on *T. seducta*, "It is with much hesitation that I have given this specific rank"; and in his description of the species he says, "*S. socialis* var. *sobrina* persimilis, . . ." The writer, as well as Lundblad (17) has found that color has no specific value in this genus. Elsewhere in this paper the writer has stated that he regards the male claspers as the ultimate specific criteria for the species of Tenagobia, and in the above species the claspers are identical. The distribution of these three so-called species also indicates that they are one and the same species. The specimens of *T. signata* were taken on the Rio Purus, which is a southern tributary of the Amazon, and those of *T. socialis* var. *sobrina*[3] and *T. seducta* were taken on the Rio Jurua, also a tributary of the Amazon, which arises near the source of the Rio Purus.

T. simulans (White) was described from three female specimens which seem to be identical with those of *T. signata*. Since it is very difficult, if not impossible, to differentiate accurately between females of closely related species of Tenagobia, and since these specimens were taken in the Upper Amazon region within the known range of *T. signata,* but of no other species[4] of Tenagobia, the writer reduces this species to a synonym of *signata*.

Lundblad (17) besides placing the above species in synonymy with *T. signata* also reduced *T. socialis* to a variety of *T. signata* and described *T. signata* var. *incerta*. The writer holds that each of these varieties is a distinct species. Both the right and left claspers of the cotypes of *T. socialis* (Pl. XLI, figs. 9, 14) taken on the Rio Maderia and at Manaos differ markedly from those of *T. signata* (Pl. XLI, figs, 8, 12) and in addition this species has only six or seven long hair-like setae on the upper edge of the fore tarsus while *T. signata* has 10 or 11. In the case of *T. signata* var. *incerta* (Pl. XLI, figs. 10, 11) the left clasper is not very different from that of *T. signata,* but the right one is strikingly so, and the number of hair-like setae on the upper edge of the fore tarsus is six. The writer, therefore, raises *T. signata* var. *incerta* to specific rank.

T. minuta Deay (3) is a synonym of *T. costaricana* Jaczewski (11) as Jaczewski's name has priority, his description having been published in May, 1930,[5] and Deay's in June, 1930. The writer has examined the holotype of *T. costaricana*.

MATERIAL STUDIED

Approximately 11,000 specimens of Tenagobia have been examined individually by the writer during the course of this work. This material came from all of the localities in which specimens of the genus have been taken with the exception of California, the Rio

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[3] Lundblad (17) errs in giving Manaas as the type locality of *T. socialis* var. *sobrina*. White (29) states that all of the specimens were taken at Urucaca, Rio Jurua; and the cotypes which the writer examined were so labeled.

[4] The writer believes that the cotypes of *T. socialis* which were taken at Anana, Upper Amazon and on the Rio Jurua, are specimens of *T. signata* since they were taken at the same time and in the same locality as that species.

[5] The Zoölogical Record gives the date of publication of Jaczewski's papers as 1931, but the writer received a separate from Doctor Jaczewski in October, 1930, which is dated May, 1930.

Autaz, a left tributary of the Maderia river near its mouth, Venezuela and Pernambuco, Brazil.

Included in the above specimens were types of the following species: *constricta, costaricana, hungerfordi, mexicana, pulchra, selecta, serrata, signata, socialis* and *truncata;* the cotypes of the following synonyms of *signata: seducta, simulans,* and *socialis* var. *sobrina;* and specimens of *fuscata* and *incerta* which had been compared with the types.

Dr. H. B. Hungerford, who supervised this work, examined the types of the following species and compared examples of the material used in this study with them: *fuscata, incerta, melini, romani* and *schaedi.*

No specimens of *marmorata* were studied. Bergroth's collection was inaccessible and no specimens besides the type material have been taken.

MORPHOLOGY

The morphology of this genus has been much neglected. The early workers, Stål, White and Bergroth, used very few structural characters in their descriptions, and did not illustrate their publications. However, White (29) and Bergroth (1) pointed out the crescent-shaped pronotum and mentioned that the scutellum is very large. Champion (2) was the first to publish an illustration of a member of this genus. Hungerford (9) was the first to use and figure structural characters in descriptions. He used the claspers as specific criteria and pointed out that *T. selecta* is pterodimorphic. Lundblad (17) in 1928 redescribed Stål's and White's species and described three species and one variety as new to science. He used structural characters to differentiate the species and published twenty-two text figures, illustrating forelegs, prothoraces, abdominal segments and claspers, and one plate of photographs of wings. Although Lundblad scattered his remarks on the morphology through his specific descriptions, he has contributed more to the morphology of the genus than any other writer. His outstanding contributions are that one species, *T. schadei,* does not possess minute peg-like setae on the hemelytra and that a strigil is absent in the members of this genus. Jaczewski (11) and Deay (3) based their species on structural characters and illustrated their papers.

GENERAL APPEARANCE. The members of this genus (Pl. XXXVIII, figs. 4,7) are elliptical in shape, with the body slightly convex. The head, as in all corixids, overlaps the prothorax, which in turn overlaps the mesothorax. The pronotum is wider than long and is crescent-shaped. The scutellum is triangular, and longer than the pronotum. The hemelytra slightly exceed the apex of the abdomen, the right overlapping the left when at rest.

All of the known members of the genus are small, ranging in length from 1.8 mm. (*costaricana*[6]) to 4.8 mm. (*selecta*), and in width across the head from 0.75 mm. (*costaricana*) to 1.8 mm. (*selecta*).

The color of the members of the genus ranges from a transparent yellow to dark brown. As a rule the hemelytra are more or less indistinctly mottled, but they may be uniformly colored; the venter and legs are usually uniformly colored and lighter than the dorsal parts. Color is of little or no taxonomic significance in this genus.

The following secondary sexual characters are present: right-sided asymmetry of the abdomen in the males (Pl. XXXVIII, figs. 9, 12); the tibia and tarsus of the forelegs of the females fused into a tibia-tarsus (Pl. XXXVIII, fig. 1) and the tarsal claw of the forelegs of the males developed into a large, fleshy club-like structure which folds into an excavation in the outer side of the tarsus.

THE HEAD. It is triangular in outline, a little wider than the prothorax; the front convex, sides subangular; in dorsal aspect (including the eyes) obtuse triangular; hypognathous, the oral opening directed ventrocaudally, lying between the forelegs (Pl. XXXIX, fig. 22). The posterior margin of the vertex is usually sinuate with a median tubercle (Pl. XXXVIII, figs. 2, 4, 7; Pl. XXXIX, fig. 1). The vertex is separated from the postocular sclerites by distinct sutures ("impressed lines" of Bergroth). These sutures may bend laterally, extend straight back (Pl. XXXIX, fig. 4) or curve mesally (Pl. XXXIX, fig. 3), thus making the caudolateral angles of the vertex acute, right, or obtuse. An eye may be either wider or narrower than the dorsal interocular space, according to the species. Ocelli are absent. The antennae (Pl. XXXIX, fig. 9) are very short, three-segmented, and concealed in grooves on the underside of the head. The second segment is the shortest and the third the longest. The latter is thickly covered with numerous short hairs, and on the underside there are several longer setae, some of which are extremely long. The mouthparts (Pl. XXXIX, figs. 18-22) consist of the labium, which forms the so-called rostrum, and the stylets. The oral opening is at the front rather than at the tip of the rostrum. The stylets are short and stout. The mandibles are toothed on the outside and are more slender than the maxillae, which are semicylindrical. The left maxilla is larger than the right, which it partly encloses. The teeth on the mandibles and the right maxilla are not as prominent as Hungerford (8) shows in his illustration of the mouthparts of a corixid.

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[6] Jaczewski (11) gives the length of the holotype of this species as 1.3 mm., but the writer measured the holotype by using a micrometer eyepiece under a magnification of 120 × and found it to be 1.8 mm. long.

The Thorax. The three segments of the thorax are distinct. The prothorax (Pl. XXXVIII, figs. 4, 7; Pl. XXXIX, figs. 1, 4, 13, 17) overlaps the mesothorax and is but loosely fastened to it. The tergum of the prothorax consists of but one sclerite and is referred to as the pronotum. Taxonomically the shape of the pronotum is of great significance, for it is upon the character of its crescent-shaped pronotum that the genus is based. The pronotum is approximately the same width as the head; its cephalis margin is angulate and its caudal margin concavely arcuate in front of the base of the scutellum, and either truncate (Pl. XXXVIII, fig. 4; Pl. XXXIX, fig. 1) in front of the bases of the hemelytra or with the lateral margins narrow (Pl. XXXVIII, fig. 7; Pl. XXXIX, fig. 4). The pleuron (Pl. XXXIX, figs. 13, 17) is divided into epimeron and episternum by a well-defined pleural suture. The epimeron in some species bears an upwardly directed group of hairs (Pl. XXXIX, fig. 13) which Lundblad (17) has aptly named the "mustache-like bristles" (schnurrbartänliche Haare). The presternum is fused with the episternum.

The mesothorax is very closely connected with the metathorax. Its tergum is divided into praescutum, scutum, and scutellum. The latter is the part that is visible when the hemelytra are still attached. The scutellum is comparatively large in the members of this genus, being always longer than the pronotum and usually twice as long. It varies in size within the same species, depending upon whether the wings are functional or not, being larger when the wings are functional (see "structural characteristics" under *T. selecta* and *T. fuscata*). The pleuron is partly divided into an episternum, which is fused with the sternum, and an epimeron. These plates extend over the coxae. The pleural suture is distinct from the caudal margin of the pleuron to a point about halfway through the pleuron. The mesosternum is a single plate which is fused with the episterna laterally. The spiracles of this segment are on the intersegmental membrane between the pro- and mesothorax.

The tergum of the metathorax consists of a single plate representing the fused prescutum, scutum and scutellum. The pleuron is very narrow and lies dorsally above the sternum and is divided into episternum and epimeron. The pleural suture runs nearly transversely. The metacoxa, whose base is covered by the metasternum, articulates with the coxal processes of the pleuron. The metasternum is a very large, single plate covering the entire ventral aspect of the metathorax. The second thoracic spiracle is located at the border of the meso- and metathoracic boundary in a cavity bounded laterally by the epimeron of the mesothorax and the sternum of the metathorax and dorsally by the projecting edge of the mesonotum and the pleuron of the metathorax. In this cavity also is a complicated structure which is structurally the same as the so-called tympanal organ which Garner found in Corixa in 1865 and which was described in detail by Hagemann (7) in 1910. This structure also occurs in Micronecta. The organ is located above the second spiracle and consists of a peculiarly striated tympanum, in the central part of which is a hump from which projects a club-like organ. In the cephalic margin of the hump is a small knob-like structure from whose inner side an innervated cell connects with the central nervous system. From the second spiracle a tracheal trunk runs dorsad with its walls close to the inner side of the striated tympanum, which is, therefore, bordered on both sides by an air chamber. It has not been experimentally proved that this is an auditory organ even in *Corixa geoffroyi* Leach and *Micronecta minutissima* (Linn.) where the investigators worked with live material. The writer has had no live material of Tenagobia with which to experiment. The structure of the organ, however, suggests that it is auditory in function, or, as pointed out by Weber (28), it may be an organ of touch, since Hagemann (7) found that *Corixa geoffroyi* responded to blows on the aquarium but not to the tone of the violin. If the organ in Tenagobia is identical with that in Corixa and Micronecta, and from its appearance it seems to be, then its presence in this genus lends support to Hagemann's contention that the large claw of the foretarsus is a sound-producing organ in Micronecta, for no other of the supposedly sound-producing organs, as pegs on the foretarsus and the strigil, are present in Tenagobia. The club-like organ described above is not innervated, so it is not considered to have any bearing on sound reception. Hagemann thinks they might serve to balance the insect in flight, since they are shaped much like the halteres of Diptera.

In the adults there are pairs of small openings on the underside of the thorax on the suture between the mesoepimeron and the metasternum which appear to be the ostioles of the scent glands.

In the nymphs the scent glands open on the dorsal aspect of the abdomen.

THE ABDOMEN (Pl. XXXVIII, figs. 9, 12). In Tenagobia the abdomen consists of seven visible segments, which are segments two to eight, the first abdominal segment, as in other Hemiptera, having been lost. The ninth abdominal segment, the genital capsule (Pl. XXXIX, fig. 8), is enclosed within the eighth. In the females the abdominal segments are symmetrical, but in the males the segments, commencing with the fifth, exhibit right-sided asymmetry. The left half of the eighth tergite (Pls. XXXVIII and XXXIX) is well developed, but the right half is practically missing. The median part of the right half of this tergite has become developed into the form of a lobe which reaches its greatest specialization in *T. selecta* (P. XXXVIII, fig. 12) where it has become a long finger-like process. The shape of this lobe, and the number of hair-like setae which it bears, is unique for each species of the genus except in those of the *signata* group. The lateral margins of each abdominal segment bear spine-like and many finer setae, some of the latter being long and hair-like. The number of spine-like setae is constant within a species. In some species the sixth abdominal tergum is deeply cleft near the right edge (Pl. XXXVIII, fig. 12) and along this cleft is a row of hair-like setae. This row of hairs occupies the same position as does the strigil in Micronecta (P. XXXVIII, fig. 10, s). The species exhibiting this character all belong to the *hungerfordi* group with the exception of *T. selecta*, which would seem to indicate that the two main groups of Tenagobia have developed along parallel lines. The presence of this row of spines in the cleft on the sixth tergite suggests to the writer that here we may have an incipient strigil. The inner half of both the right and left margins of the eighth segment is beset with numerous hairs, arranged more or less in rows. These hairs as a rule are bent over at the tip and are usually thickened towards the ends. The genital capsule of *T. constricta* is shown in figure 8 of Plate XXXIX; those of the other members of the genus are much the same. The penis is thickly beset with barbs at its distal end.

The right clasper (Pls. XL and XLI) in Tenagobia as in Micronecta is either larger or equal to the left in size. This condition is reversed in members of the subfamily Corixinae where in cases of right-sided asymmetry, the right clasper is the smaller. The left clasper, although usually smaller in size, has, however, become much more specialized than the right.

THE LEGS. The legs of the members of this genus are much like those of Micronecta. In the males the forelegs (Pl. XLII) have some very good taxonomic characters. Each fore femur has a row of spine-like setae, varying from two to nine in number, on the inner side. In addition a strong spur-like seta (Pl. XLII, figs. 2, 3) is found on the lower margin in the members of the *signata* group. Besides the above setae, there are a few other spine-like setae and some fine hair-like setae on the fore femur. The tibia is usually shorter than the tarsus and bears a few rather large setae. The one-segmented tarsus with its large, club-like tarsal claw is the most striking part of the foreleg. The tarsus bears three rows of setae on its inner surface which the writer has designated as the lower, inner and upper rows. The setae in the lower row are bristle-like; those in the inner row are usually small and fine, but in some cases they are rather spine-like; and those in the upper row are long and hair-like. The number of these setae is fairly constant within the species. The outside of the tarsus is excavated so that the large club-like tarsal claw can be folded back into it. The tarsus bears no palal, or tarsal, pegs. In the females, the fore tibia and tarsus have fused to form a tibia-tarsus (Pl. XXXVIII, fig. 1). Judging from their structure, the function of the forelegs in Tenagobia is the same as in other corixids, that is, to sweep the ooze from the pools and streams in which they live up to their mouthparts (Pl. XXXIX, fig. 22).

The middle legs (Pl. XXXVIII, fig. 11) are long and slender. The tarsus is one-segmented and there are two long, slender tarsal claws.

The hindlegs (Pl. XXXVIII, fig. 6) are fringed with long hairs. The tarsus is two segmented. The single tarsal claw (Pl. XXXVIII, figs. 3, 5) is terminal and may be either two- or three-pronged, depending on the species.

THE HEMELYTRA. The hemelytra are well developed and exceed the abdomen slightly in length. Each is divided into a clavus, corium, and a more or less distinct membrane. There is also a deep impression (*fossette subcostale* of Poisson [19]) along the lateral margin of the corium which, according to Abbott, forms an embolium. The membranal suture is not very distinct, and is usually more so in the right than in the left hemelytron. The membrane is developed in proportion to the development of the wings. The distal end of the right hemelytron overlaps the left when they are folded on the insect's back. All of the members of the genus, both male and female, possess a wing-coupling apparatus (*l'appariel d'accrochage* of Poisson), which is a paired structure that is situated just in front of the apex of the clavus on the median margin of each hemelytron. Except in a single known species, *T. schadei,* the hemelytra are beset on their dorsal surface with many minute peg-like setae which are scattered irregularly over the clavus and corium. The hemelytra also bear some fine setae which are long and hair-like in some species, as *T. fuscata.*

THE WINGS. The wings are present and fully developed in all of the specimens which the writer has examined except in the case of two species, *T. selecta* and *T. fuscata.* The writer has seen no specimens of *T. fuscata* that have had fully developed wings; the wings in the specimens which he has examined were either absent or very short. They are absent in the type according to Lundblad (17). The writer has seen specimens of *T. selecta* with fully developed wings, others with short wings, and still others with no wings. As pointed out previously the size of the scutellum and the membrane in the hemelytron varies in direct proportion to the development of the wings.

CHARACTERS USED IN CLASSIFICATION

The females of closely related species of Tenagobia, as of other corixids, are very difficult, if not impossible, to distinguish from each other; therefore, all of the specific descriptions are based upon male characters. Although the males of some of the species of Tenagobia appear superficially to be indistinguishable, they all possess structural characters by which they may be distinguished from each other. In some cases these characters are so minute that they need to be examined with the "high power" of a compound microscope or even under an oil emersion objective. For this reason the specimens studied must for the most part be dissected and mounted upon slides.

Ferris (4) defines a species as follows: "If a group of closely similar individuals, or an individual which may represent such a group, is distinguished from another by one or more nonintergrading, structural characters, it may be regarded as a species, unless and until it can be shown not to merit that distinction." The writer has followed Ferris' definition in segregating the species of Tenagobia.

Many of the structural characters found in the genus are present in two or more species; and it is therefore possible to arrange the species in groups, the members of each group being closely related to each other. These characters are: The presence or absence of mustache-like bristles on the lateral margins of the epimera of the prothorax; the general structure of the male claspers; pronotum truncate in front of bases of hemelytra or not; the presence or absence of a spur-like seta on the lower side of fore femur; the relation of the width of the eyes to the interocular space.

The ultimate specific characters used by the writer are the shape of the claspers in the males and the absence of setae on the hemelytra in one species, *T. schadei.* Other characters constant within a species, but not always unique for a species are: the relative widths of an eye and the vertex between the eyes; the number of spine-like setae in the row on the inner side of the fore femur, which varies in a few species; the approximate number of setae in each of the rows on the fore tarsus; the relative lengths of the pronotum, and from the apex of the scutellum to the apex of the clavus; the relative lengths of the femur, tibia, tarsus, and tarsal claws of the middle legs; the number of spine-like setae on the lateral margins of the abdominal segments; the shape of the tergite lobe of the eighth abdominal segment; and the approximate number of hair-like setae which it bears.

Any nonintergrading structural character is in the writer's opinion a good specific criterion when one is dealing with morphological species.

RELATIONSHIPS

The genus Tenagobia belongs to the family Corixidae, whose members are probably the most specialized of the Hemiptera. The family is composed of the subfamilies Diaprepocorinae, Micronectinae and Corixinae. Tenagobia is one of the four genera composing the subfamily Micronectinae.

The subfamily Diaprepocorinae is both structurally and distributionally the most primitive of the three subfamilies. It contains but the one genus, Diaprepocoris, which is represented by three species which have been taken only in Southern Australia, Tasmania and New Zealand. Among the primitive characters found in this subfamily are two ocelli, which are found in no other Corixidae and as a rule in no other water bugs; the slightness of the asymmetry of the male abdomen—superficially the two sexes cannot be distinguished unless the wings are spread; the fore tarsi similar in both sexes with the tarsal claw stout, resembling a second tarsal segment[7]; and ab-

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[7] According to Hale (6) this character is also found in the genus Cymatia of the Corixinae.

sence of a strigil. However, the males of this genus possess a stridulatory apparatus, composed of two parts, located on the tergum of the fifth abdominal segment.

In general the Micronectinae, except in having three-segmented antennae, are structurally more primitive than the Corixinae. They are characterized by having three-segmented antennae; the scutellum free and visible as in most other aquatic as well as terrestrial Hemiptera; the hind tarsal claw apical; and the stridulatory pegs absent on the fore tarsus of the males. The Corixinae are characterized by having four-segmented antennae; a large pronotum which covers the scutellum entirely or almost entirely; the hind tarsal claw much more developed than in Micronectinae, anteapical, on the inner edge of the tarsus; and stridulatory pegs on the fore tarsus of the males except in the genus Cymatia. The asymmetry of the male abdomen is much more pronounced in this subfamily than in the other and the hind legs are better fitted for swimming.

The subfamily Micronectinae is composed of four genera: Micronecta Kirkaldy, Tenagobia Bergroth, Synaptonecta Lundblad and Micronectella Lundblad.

The members of the genus Micronecta are the closest relatives of the Tenagobia. These two genera present a striking example of parallelism of development, as they are structurally much alike and occupy comparable ranges in the Eastern and Western Hemispheres. They differ structurally in that both the anterior and posterior margins of the pronotum are convex in Micronecta (Pl. XXXVIII, fig. 8) while in Tenagobia the posterior margin of the pronotum is concavely arcuate (Pl. XXXVIII, figs. 4, 7), thus making the exposed portion of the scutellum much greater in Tenagobia; and in that the males of Micronecta possess a weakly developed strigil (Pl. XXXVIII, fig. 10), this structure being absent in Tenagobia. The claspers of the males, especially the left one, are more complicated in structure in Tenagobia. In all other characters the two genera are strikingly similar. The posterior enlargement of the pronotum in Micronecta provides a larger chamber for the storage of air for use when the insect submerges than in Tenagobia, thus making Micronecta better fitted for an aquatic existence. This fact and the presence of the strigil are evidence that Micronecta is the more specialized.

Although the range of these two genera are parallel in that they occupy comparable ranges in the Eastern and Western Hemispheres, Micronecta has much the wider distribution. It has been taken in Australia, the East Indies, Africa, Asia as far north as Manchuria, and Europe as far north as the Arctic Circle. Tenagobia on the other hand is restricted to the Western Hemisphere between the 35th parallels (Pl. XLIII). Bergroth (1) suggests that Micronecta probably occurs in British Columbia, but it has not been taken there as yet.

The genera Synaptonecta and Micronectella were described by Lundblad (18) in 1933 from Java; the former being based on a single male specimen and the latter on three male and one female specimens. These genera appear to be very close to Micronecta. Synaptonecta, represented by the one species, *S. breddini* Lundblad, is according to Lundblad very close to *Micronecta haliploides* Horvath. The important generic criterion of the genus and the one which distinguishes it from Micronecta is that the tibia and tarsus of the foreleg of the male are fused, thereby forming a tibia-tarsus as in the females of Micronecta and the other genera of the subfamily. The genus Micronectella is based on the species *M. acuta* Lundblad and differs from Micronecta in that the males possess no strigil.

The genus Tenagobia may be separated from the other members of the family Corixidae by the following key:

1. Scutellum covered by the pronotum (rarely not at apex); antennae 4-segmented; hind tarsal claw anteapical, on inner edge of tarsus........*Subfamily Corixinae.*
   Scutellum covered by pronotum only at the anterior margin; antennae 3-segmented; hind tarsal claw apical........ 2
2. Two ocelli present; fore tarsal claw large, suggesting a second tarsal segment. *Subfamily Diaprepocorinae.*
   Ocelli absent; fore tarsal claw of females spine-like, of males large, fleshy and capable of being folded back into an excavation on the outside of the tarsus. *Subfamily Micronectinae* 3
3. Strigil present in males........ 4
   Strigil absent in males........ 5
4. Fore tibia and tarsus of male fused into a tibia-tarsus. Known only from Java. *Synaptonecta.*
   Fore tibia and fore tarsus of male distinctly separated. A widely distributed genus........*Micronecta.*
5. Pronotum convex on anterior and posterior margins. Known only from Java. *Micronectella.*
   Pronotum crescent shaped, anterior margin convex, posterior margin concave. Known only from the new world........*Tenagobia.*

DESCRIPTION OF THE GENUS

GENUS TENAGOBIA BERGROTH

(Haplotype *marmorata* Bergroth)

1899. Tenagobia Bergroth. *Ent. Mo. Mag.*, ser. 2, X(35): 282.

1906. Tenagobia Bergroth. Kirkaldy, G. W., *Trans. Am. Ent. Soc.*, XXXII: 152.

1908. Tenagobia Bergroth. Kirkaldy, G. W., and J. R. de la Torre-Bueno. *Proc. Ent. Soc. Wash.*, X: 193.

1917. Tenagobia Bergroth. Lundblad, O. *Ark. f. Zool.*, XXA (7): 4.

Original Description. "Pronotum lunuliforme, medio quam leteribus haud multo longius, margine antico rotundato, margine postico fere toto vel saltem ante scutellum plus minusve profunde arcuato-sinuato. Scutellum magnum, pronoto longius, saepe multo longius. Cetera ut in genere Micronecta, Kirk."

Writer's Description. Corixids with three-segmented antennae; ocelli absent; pronotum convex in front and concavely arcuate behind, covering but anterior part of scutellum which is large; so-called tympanal organ in metathorax present; strigil absent; abdomen in males with right-sided asymmetry; fore tibia and tarsus in females fused into a tibiatarsus; fore tarus in males one-segmented, without stridulatory pegs, and excavated on outer surface to receive the large, fleshy, movable tarsal claw; a single, apical hind tarsal claw.

This genus is very close to Micronecta Kirkaldy from which it is distinguished by the crescent-shaped pronotum and absence of a strigil in the males. It is distinguished from the other two genera of the subfamily Micronectinae by the characters given in the key on page 424.

GROUPS WITHIN THE GENUS

On the basis of their structural characteristics the genus can be divided into two major and five minor groups. The presence or absence of a group of mustache-like bristles on the lateral margins of the epimera of the prothorax (Pl. XXXIX, figs. 15, 17) divides the species of the genus into two major groups.

Group I, those possessing mustache-like bristles, is composed of the following species: *constricta, fuscata, hungerfordi, melini, romani,* and *schadei.* The species within Group I form two distinct groups which the writer wishes to designate as the "*constricta* group" and the "*hungerfordi* group." The *constricta* group, composed of *constricta* and *romani,* is a very distinct one and possesses the following characters: an eye at least one-fourth times wider than the interocular space, long, slender forelegs which have but two spine-like setae on each femur, and claspers (Pl. XL, figs. 4, 7) which are very different in shape from that of the other known species. The *hungerfordi* group, composed of *fuscata, hungerfordi, melini,* and *schadei,* is not as sharply defined as the *constricta* group, but the species composing it have the following characters in common: each fore femur bears five or more spine-like setae (*selecta* is the only other species having this many); the left clasper of each (Pl. XL, figs. 2, 3, 8, 13) has a brown, stiff projection on the inner side near the base; the right side of the sixth abdominal tergum has a deep cleft which bears a row of simple setae (also present in *selecta*); and the size and shape of the four species are similar. Of the species in this group, *schadei* is unique in that it is the only species of Tenagobia known which has no minute peg-like setae on the hemelytra. In all other characters, however, this species is much like *hungerfordi* and *melini*. *T. fuscata* does not seem to be closely related to the other species of this group. The claspers, aside from the projection on the right one, are much different and the wings are either absent or reduced to mere vestiges, an evidence of specialization.

Group II, consisting of those species which do not have mustache-like bristles on the lateral margins of the prothorax (Pl. XXXIX, fig. 17), includes the following species: *costaricana, incerta, mexicana, marmorata* (in all probability), *pulchra, selecta, serrata, signata, socialis* and *truncata*. These species fall into three clearly delimited groups which the writer designates as the "*truncata* group," the "*signata* group," and the "*selecta* group" although this last group contains but the one species. *T. costaricana, marmorata, pulchra,* and *truncata* compose the *truncata* group, which is characterized by the fact that the posterior margin of the pronotum is truncate in front of the bases of the hemelytra. The members of this group are the smallest of the known species of Tenagobia and are very similar to each other. The *signata* group, composed of *incerta, mexicana, serrata, signata,* and *socialis,* is characterized by the large spur-like seta on the lower margin of the fore femur. The species of this group are very similar in appearance and can be definitely distinguished from each other only by the claspers. In fact, Lundblad (17) considers this group to be but a single species, *signata,* and its varieties. The remaining species, *selecta,* of Group II is very distinct from any of the other species of the genus. It is not only the largest of the species, but the tergite lobe of the eighth abdominal segment (Pl. XXXVIII, fig. 12) has become developed into a peculiarly shaped finger-like process. Its claspers are also different from those of any other species of the genus, the left (Pl. XL, fig. 14), however, is somewhat like that of *fuscata*. The number of spine-like setae on the fore femur and the cleft in the right side of the sixth abdominal tergum (Pl. XXXVIII, fig. 12) which bears a row of simple setae are the same characters which are found in the *hungerfordi* group of Group I. Whether these last characters are more indicative of relationship than the mustache-like bristles on the lateral margins of the epimera of the prothorax, the writer is unable to say.

SUMMARY OF GROUPS WITHIN THE GENUS

GROUP I. Characterized by the presence of mustache-like bristles on the epimera of the prothorax.

1. The *constricta* group.........	*T. constricta* *T. romani*
2. The *hungerfordi* group........	*T. fuscata* *T. hungerfordi* *T. melini* *T. schadei*

GROUP II. Characterized by the absence of mustache-like bristles on the epimera of the prothorax.

1. The *truncata* group..........	*T. costaricana* *T. marmorata* *T. pulchra* *T. truncata*
2. The *signata* group............	*T. incerta* *T. mexicana* *T. serrata* *T. signata* *T. socialis*
3. The *selecta* group............	*T. selecta*

DISTRIBUTION

The insects belonging to the genus Tenagobia are confined to the Neotropical and southern extremity of the Nearctic Regions. The known range of the genus is shown in Plate XLIII. The numbers on this plate mark the places where material has been collected except "1" which represents Uhler's (26) California record and "17" which represents the type locality of *T. marmorata,* the actual locality in Venezuela where this species was taken not being known. Although many more data are needed to determine the range of most of the species, the extreme limits of the range of the genus are rather definitely known. This statement is based on evidence which is difficult to show graphically. The map (Pl. XLIII) shows the localities in which members of the genus have been taken, but gives no indication of the many other localities in which collections have been made without securing specimens of the genus. For example, Dr. R. H. Beamer of the University of Kansas has made intensive and extensive collections of the hemipterous fauna along the boundary of the United States and Mexico, but has not taken a single specimen of Tenagobia. This is very good evidence that no members of the genus occur in the southern United States at present.

One of the most striking features of the distribution of the genus is that it extends almost equal distance north and south of the equator. The extreme limits of north and south distribution are California (33° ? N. lat.) and Buenos Aires (35° S. lat.). The northern record is that of Uhler (26) and he does not state in what part of

California the specimens which he saw were taken. The most northerly locality from which the writer has seen specimens is Nainari, Sonora, Mexico (28° N. lat.).

The members of the genus seem to be confined principally to regions of low altitudes. Most of the specimens have been taken in localities below an altitude of 250 feet. Indeed, specimens have been collected at but six places which have an altitude of over 1,000 feet. These are Cuernavaca, Morelos, Mexico, 5,418 feet altitude, where one specimen was taken at light; Puerto Bermudez, Rio Pichis, Peru, between 1,000 and 2,000 feet altitude; Rio Mapiri, Bolivia, 1,400 feet altitude; Santa Cruz, Bolivia, 1,350 feet altitude; and Piropara and Lassance, Minas Geraes, Brazil, about 1,000 feet altitude.

The range of the genus, except for California on the north, Buenos Aires and Montevideo on the south, and the few localities above 1,000 feet altitude, lies within the *tierra caliente* thermal region, that is, the region having a mean annual temperature above 72.5° F. The highest mean annual temperature of any place in the genus range is 82.2° F. (Manaos, Brazil) and the lowest 60.7° F. (Montevideo, Uruguay).[8] The maximum temperature ever recorded within the range is 109° F. (Montevideo) and the minimum 25° F. (Montevideo). This dependence upon high temperatures explains the restriction of the genus to the costal streams of Mexico and also why it does not occur south or west of Buenos Aires. It seems to the writer that members of the genus can undoubtedly be found in fresh water anywhere in their range where the minimum temperatures are very little below freezing.

Although as stated above more data are needed before definite conclusions can be drawn about the distribution of the species, the writer believes that the following discussion will be of some value, since he has examined material from many localities which have not been mentioned in the literature.

The species of Group I (Pl. XLVI) have been taken as yet only south of the equator. *T. fuscata* seems to be confined to the region south of the Tropic of Capricorn, therefore occupying territory to the south of the range of the other species of the genus. *T. schadei* has been taken at Villa Rica, Paraguay, and Pernambuco, Brazil, indicating that it occurs throughout the Brazilian highlands. *T. hungerfordi* has been taken in Paraguay, Corumba, Matto Grosso, Brazil, and Province del Sara, Bolivia, indicating that it has a more westernly distribution than does *T. schadei.* The fourth species of the *hungerfordi* group, *T. melini,* and the two species of the *constricta* group, *T. romani* and *T. constricta,* have been taken only in their type localities, Manaos, Brazil, and Tena, Ecuador, respectively.

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[8] The data in regard to temperatures and elevations were obtained from Page's (18) and Reed's (20 and 21) works.

Group II (Pls. XLIII, XLIV, XLV) has a wider range than Group I, its species being distributed equal distances north and south of the equator, but none of its species has been taken as far south as has *T. fuscata.* There is but a small amount of data available concerning the distribution of the *truncata* group (Pl. XLIV), *marmorata, pulchra* and *truncata* each having been taken in but one locality. *T. costaricana,* however, has been taken in three localities. However, since they have been taken in no other localities, it seems logical to suppose that this group is confined to the eastern slopes of the Andes north of 20° south latitude, Venezuela, Colombia (probably), Central America, and possibly the lowlands of southern Mexico. The *signata* group has a much wider range than any of the other groups and seemingly is much more abundant in individuals as its members are collected more frequently than are those of the other groups. *T. mexicana* is the northern member of this group (Pl. XLIII), and it has been taken from California to Panama. *T. signata* (Pl. XLV) seems to be confined to the upper Amazon and its tributaries. *T. socialis* ranges from Sao Antonio da Boa Vista on the Maderia river north and east to the Guianas. *T. incerta* has a very wide distribution. It has been taken from Grenada and Trinidad on the north to Paraguay on the south and from Pernambuco on the east to Bermudez, Rio Pichis, Peru, on the west. It has not appeared among the many specimens collected in British and Dutch Guiana, is very abundant at Manaos, does not appear among the specimens taken by Traill in the Upper Amazon, Maderia, Purus and Jurua rivers, but does appear in Peru and Bolivia in the headwaters of the Amazon and Maderia rivers. It is abundant in Paraguay, has been taken in the headwaters of the San Francisco river, at Pernambuco on the east coast and at Para at the mouth of the Tocantins river. Collections on the Rio Negro and the Orinoco and tributaries which connect these river systems may yield specimens of this species which will explain why it is present in Trinidad and Grenada but not in British Guiana. *T. serrata* has been taken but once, in the Lower Mamore river in Bolivia. *T. selecta* (Pl. XLIV) has been taken in the Amazon region around Manaos, in Bolivia and in Paraguay. It seems to be especially abundant in the region around Manaos. These collection places must mark the boundaries of its distribution rather definitely because it is so large in comparison with the other species of the genus that it would not likely be unnoticed by the collector.

No specimens of the genus have been taken in Colombia, although they should occur in its northern part, nor have any specimens been taken west of the Andes.

Judging from our present knowledge of the distribution of the genus, the highlands between the Amazon and the Paraguay river systems, made up largely of the Plateau of Matto Grosso, is the primary center of dispersal of the species. However, this statement is at best but a mere guess, for until many more collections have been made within the known range of the genus, nothing definite can be said of the complete distribution of the species, let alone the center of dispersal.

KEY TO THE SPECIES OF TENAGOBIA (MALES)

1. Hemelytra without minute peg-like setae; claspers as in figures 1 and 3, Plate XL .... *T. schadei* Lundblad, p. 435

Hemelytra beset with minute peg-like setae, sometimes not visible under low power, 2

2 (1). Pronotum truncate in front of bases of hemelytra, not narrowed at the ends (Plate XXXIX, fig. 1) 3

Pronotum not truncate in front of bases of hemelytra, narrowed at ends (Plate XXXIX, fig. 4) 6

3 (2). Scutellum but little longer than pronotum; has been taken in Venezuela only. *T. marmorata* Bergroth, p. 439

Scutellum twice as long, or nearly twice as long as pronotum 4

4 (3). Fore tarsus as long as tibia (Plate XLII, fig. 11); 5th segment of abdomen with 1 spine-like seta on each lateral margin, 6th segment with 2 spine-like setae on each lateral margin, claspers as in figures 1 and 4, Plate XLI; known only from Panama, Costa Rica and Honduras...... *T. costaricana* Jaczewski, p. 437

Fore tarsus shorter than the tibia; 5th abdominal segment with 3 spine-like setae on each lateral margin, 6th with 3 or 4 spine-like setae on each lateral margin 5

5 (4). Sixth abdominal segment with 3 spine-like setae on either side; 5 long hair-like setae in upper row and 17 bristle-like setae in lower row on fore tarsus; claspers as in figures 2 and 5, Plate XLI; known only from Bolivia. *T. pulchra* Hungerford, p. 440

Sixth abdominal segment with 4 spine-like setae on each lateral margin; 4 long hair-like setae in upper row and 14 bristle-like setae in lower row on fore tarsus; left clasper as in figure 3, Plate XLI; known only from Ecuador. *T. truncata* Deay, p. 441

6 (2). Fore femur with a papilla-like projection on lower side from which arises a stiff spur (Plate XLII, figs. 2 and 3), a row of 4 spine-like setae on inner side, 7

Fore femur without a papilla-like projection or spur on lower side, the row of spine-like setae on inner side either more or less than 4 in number........... 11

7 (6). Heel of left clasper acute and well developed (Plate XLI, fig. 6); right clasper as in figure 13, Plate XLI...................... *T. mexicana* Deay, p. 448

Heel of left clasper rounded, not produced (Plate XLI, figs. 7, 8, 9 and 10); right clasper not as above (Plate XLI, figs. 11, 12, 14 and 15).................. 8

8 (7). Right clasper with a double row of serratures ventrally, heel very acutely angled (Plate XLI, fig. 15); the left as in figure 7, Plate XLI. *T. serrata* Deay, p. 450

Right clasper without a double row of serratures ventrally (Plate XLI; figs. 11, 12 and 14).. 9

9 (8). Toe of left clasper suddenly produced into a definitely rounded point (Plate XLI, fig. 9); heel of the right acute, toe much rounded (Plate XLI, fig. 14). *T. socialis* (White), p. 451

Toe of left clasper not suddenly produced into a rounded point (Plate XLI, figs. 8 and 10); right clasper (Plate XLI, figs. 11 and 12) not as in *socialis*...... 10

10 (9). Toe of right clasper bluntly rounded, not much produced, heel not projected, right angled (Plate XLI, fig. 12); left clasper as in figure 8, Plate XLI. *T. signata* (White), p. 443

Toe of right clasper much produced, heel produced acutely angled (Plate XLI, fig. 11); left clasper as in figure 10, Plate XLI........*T. incerta* Lundblad, p. 446

11 (6). Tergite lobe of 8th abdominal segment produced into a long finger-like process (Plate XXXVIII, fig. 12).............................*T. selecta* (White), p. 452

Tergite lobe of 8th abdominal segment normal, not produced into a long finger-like process (Plate XXXIX, fig. 11)...................................... 12

12 (11). An eye about 1¼ times wider than interocular space (Plate XXXIX, fig. 4), 13

An eye narrower than interocular space (Plate XXXIX, fig. 3)................ 15

13 (12). Three lateral and 1 terminal spine-like setae on each lateral margin of 8th abdominal segment; 7-9 spine-like setae on inner side of fore femur; claspers as in figures 8 and 9, Plate XL.........................*T. fuscata* (Stal), p. 429

One or 2 lateral and 1 terminal spine-like setae on each lateral margin of 8th abdominal segment; 2 spine-like setae on inner side of fore femur.......... 14

14 (13). Twenty-two bristle-like setae in lower row on fore tarsus (Plate XLII, fig. 6); 2 spine-like setae on each lateral margin of 8th abdominal segment; claspers as in figures 4 and 5, Plate XL..............*T. romani* Lundblad, p. 427

Fourteen bristle-like setae in lower row on fore tarsus (Plate XLII, fig. 8); 1 spine-like seta on each lateral margin of 8th abdominal segment; claspers as in figures 6 and 7, Plate XL..........................*T. constricta* Deay, p. 425

15 (12). Eighteen bristle-like setae in lower row on fore tarsus (Plate XLII, fig. 4); 1 spine-like seta on each lateral margin of 6th abdominal segment; claspers as in figures 12 and 13, Plate XL......................*T. melini* Lundblad, p. 432

Twelve bristle-like setae in lower row of fore tarsus (Plate XLII, fig. 7); 2 spine-like setae on each lateral margin of 6th abdominal segment; claspers as in figures 2 and 10, Plate XL.......................*T. hungerfordi* Deay, p. 431

DISCUSSION OF THE SPECIES[9]

Tenagobia constricta Deay

(Plate XXXIX, figs. 4, 6, 8; Plate XL, figs. 6, 7; Plate XLII, figs. 8, 9)

1930. *Tenagobia constricta* Deay. *Bull. Brook. Ent. Soc.*, XXV(3): 176-177.

Size. Length, male 2.80 mm.; female, 3.0 mm. Width of head, male 1.05 mm.; female, 1.2 mm.

Color. Uniformly fuscous brown above; front and vertex transparent yellowish-gray, posterior margin of vertex darker; lateral margins of hemelytra lighter, each with two fuscous maculations. Ventral aspect of thorax yellowish, abdomen darker; legs uniformly yellowish, slightly darker at distal ends.

Structural Characteristics of Male. Head (Pl. XXXIX, fig. 4): Posterior margin of vertex sinuate, caudolateral angles not produced

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[9] The species are arranged alphabetically under the various groups as outlined on page 421 except that *T. signata* is placed first in the *signata* group.

laterally; an eye about 1¼ times wider than interocular space; posterior margin of eyes distinctly separated from posterior margin of head. *Prothorax:* Mustache-like bristles on lateral margins; pronotum a little narrower than head, 6½ times wider than median length, 2 times wider than base of scutellum; posterior margin not truncate in front of bases of hemelytra, narrowed at ends. *Scutellum:* Lateral margins sinuate, approximately 1⅕ times wider than long. *Hemelytra:* Membranes well developed, membranal suture of right hemelytron very distinct; numerous very minute peg-like setae scattered irregularly over the hemelytra (these setae are so fine that they appear to be missing when examined under low magnification); many fine hair-like setae near caudal ends, especially on the right. Ratio of lengths of pronotum, scutellum and from apex of scutellum to apex of clavus is as 21:50:135. *Wings:* Well developed in both sexes. *Abdomen:* 6th and 7th segments each with 2 spine-like setae on either side, the 7th segment relatively long; 8th segment (Pl. XXXIX, fig. 6) with 1 lateral and 1 terminal spine-like seta on either side, tergite-lobe rather truncate at end, bearing 15 long, slender hair-like setae, projection on the mesocaudal angle of right side bearing a group of meso-caudally directed bristle-like setae. *Claspers:* The right (Pl. XL, fig. 7) has a membranous basal portion, the distal part shaped somewhat like a sled runner with a notch about midway of dorsal surface; the left (Pl. XL, fig. 6) with a membranous hairy cap set on the upturned distal end. *Genital capsule and penis* (Pl. XXXIX, fig. 8): As illustrated. *Legs:* Front (Pl. XLII, figs. 8, 9) long and slender, femur with 2 weak spine-like setae on inner side, tarsus but little longer than tibia, 13 bristle-like setae in lower row, 14 setae in inner row, and 5 long hair-like ones in upper row, tarsal claw long and slender. Ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 62:18:25:15.

Holotype. Male, Tena, Ecuador, Feb. 28, 1923 (F. X. Williams) in the Francis Huntington Snow Entomological Collection.

Allotype. As above.

Paratypes. 1 male and 14 females as above.

Distribution (Pls. XLIII and XLVI). Only the type specimens have been taken.

Comparative Notes. This species and the next, *T. romani,* are very similar. They agree in size, shape and in the fact that each has 2 spine-like setae on each front femur. They differ in the shapes of the claspers, although the right ones are very similar, in the number of bristle-like setae on the lower edge of the fore tarsus, *T. romani* having about 22 and *constricta* only 13, in the fact that in *romani* there are 2 lateral spine-like setae on the 8th abdominal segment and in *constricta* only 1.

Tenagobia romani Lundblad

(Plate XXXIX, fig. 10; Plate XL, figs. 4, 5; Plate XLIII, fig. 6)

1928. *Tenagobia romani* Lundblad. *Ark. f. Zool.* Bd. XXA (7): pp. 25-28.

Original Description:

"1. *Halbdecken.* Mit deutlichen, helleren Tropfenflecken auf dem brauen Grunde. Clavus basal mit hellem Felde; Marginalarea etwa in der Mitte mit einem sehr deutlichen, brauen Fleck. Ausserdem kleinere Flecke. Membran und Flügel gut entwickelt; Membransaum des rechten Deckflügels hell und recht deutlich. Dorne kommen in ziemlich grosser Menge vor, aber sie sind ganz ausserordentlich wingzig und scheinen bei schwacher Vergrösserung zu fehlen. Besonders hinten am rechten Deckflügel sind recht viele, feine Haare vorhanden.

"2. *Antennen.* Zwei Haare sind merklich gröber als die übrigen, aber ein paar der anderen Haare erreichen annähernd dieselbe Länge.

"3. *Prothorax.* Die Schnurrbartborsten sind sehr in die Augen fallend. Die oberen sind viel grösser und länger als die mehr ventral befestigten. Die Borsten sind also hier von sehr ungleicher Länge und ungewöhnlich zahlreich. Die Epimera sind auch im übrigen mit einiger kurzen, feinen Haaren ausgestattet, während die Episterna praktisch ohne solche sind. In der seitlichen Konkavität findet man die kewöhnlichen Haare.

"4. *Vorderbein.* Der Schenkel zeichnet sich durch die schwache Bedornung und Behaarung aus. Nur 2 Basaldorne sind vorhanden und die feine Behaarung erstreckt sich nicht weit nach vorn. Auch die Palaklaue ist bemerkenswert durch ihre gestreckte Gestalt und geringe Breite. Die Aussenkanthaare sind zahlreich, etwa 22 und recht dick; die Innenkanthaare etwa 18, die langen Haare der Palaoberkante 5-6.

"5. *Mitterbein.* Dies ist durch die schöne Zeichnung äusserst charakteristisch; der Schenkel hat nämlich etwas vor der Spitze einen deutlichen, dunkelbraunen Ring, der sofort in die Augen fällt und auch bei den Nymphen vorkommt. Aber auch die Tibiabasis und Basis und Spitze des Tarsus sind ein wenig angedunkelt. Das Verhältnis Femur: Tibia: Tarsus: Klauen ist 62: 18: 25: 15.

"6. *Sechstes Abdominalsegment.* Eine rechte Zunge fehlt, dagegen ist eine linke entwickelt. Jederseits inserieren 2 Randdorne. Die Beborstung ist spärlich.

"7. *Siebentes Abdominalsegment.* Fällt durch seine Länge auf. Jederseits stehen 2 Randdorne und innerhalf des Randes zahlreiche, feine Borsten, die m. o. w. reihenförmig angeordnet sind.

"8. *Achtes Abdominalsegment.* Die Tergitzunge endet breit abgestutzt und trägt einige Haare. Die Bürstenhaare sind beinahe alle an der Spitze spatelförmig verbreitert. An dem Vorsprung rechts steht eine Gruppe von etwa 10 schief nach innen-hinten gerichteten Borsten.

"9. *Neuntes Abdominalsegment.* Das einzige beachtenswerte Merkmal ist vielleicht die recht lang und scharf ausgezogene, vordere Spitze der Genitalkapsel.

"10. *Rechter Genitalgriffel.* Recht einfach, ohne verwickelte Krümmungen und sich gegen das Ende verbreiternd.

"11. *Linker Genitalgriffel.* Mit seinen haarähnlichen, gekrümmten Verlängerungen am Ende sieht er ganz eigentümlich aus.

"*Fundort.* Mehrere Exemplare wurden von Dr. D. Melin bei Manaos, Brasilien, am 29. Oktober und 2. November, 1924, gefunden.

"Es handelt sich in *T. romani* um eine ganz besonders niedliche Art."

Writer's Description: [10]

Size. Length, male, about 2.8 mm.; width of head, male, 0.86 mm.

Color. Background of hemelytra brown mottled with distinct transparent spots; base of clavus with a transparent V-shaped figure; each lateral margin of hemelytra with a distinct brown spot near the center. Middle legs light yellow with a dark-brown ring near apex of femur; the base of the tibia and the base and distal ends of tarsus dark.

Structural Characteristics of Male. Head: An eye about 1¼ times wider than interocular space; posterior margin of eyes distinctly separated from the posterior margin of head; posterior margin of vertex with a minute median tubercle. *Prothorax:* Mustache-like bristles present on lateral margins; pronotum narrowed at ends, not truncate in front of bases of hemelytra. *Scutellum:* 0.49 mm. long. *Hemelytra:* Membranes well developed, membranal suture of right hemelytron very distinct; numerous very minute peg-like setae scattered irregularly over the hemelytra (these setae are so fine that they appear to be missing under low magnification); many fine hair-like setae on the caudal end of hemelytra, especially on the right. Ratio of lengths of scutellum and from apex of scutellum to apex of clavus is as 49:83. *Wings:* Well developed. *Abdomen:* 6th and 7th segments each with 2 spine-like setae on either side, the 7th relatively long; 8th segment (Pl. XXXIX, fig. 10) with 2 lateral and 1 terminal spine-like setae on either side, tergite lobe truncate and bears some fine hair-like setae, a projection on the mesocaudal angle of right side which bears 10 mesocaudally directed bristle-like setae. *Claspers:* The right (Pl. III, fig. 5) simple, distal end broadened, not upturned; the left (Pl. XL, fig. 4) with the distal end upturned and hairy. *Legs:* Foreleg (Pl. XLII, fig. 6) long and slender, femur with 2 weak spine-like setae in lower row, 18 setae in inner row, 5-6 hair-like ones in upper row, tarsal claw very slender. Ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 62:18:25:15.

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[10] All data given here that are not contained in the original description were supplied the writer by Doctor Lundblad through personal correspondence.

Types. Manaos, Brazil, several specimens, Oct. 29 and Nov. 2, 1924 (D. Melin), in collection of Dr. D. Melin, Zoölogical Museum, Upsala, Sweden.

The writer has not examined the types of this species nor has he seen any specimens of it. Doctor Hungerford, however, examined the types when at Stockholm in 1928 and compared examples of the writer's material with them.

Distribution (Pls. XLIII and XLVI). Only the type specimens have been taken.

Comparative Notes. See this same heading under *T. constricta.*

Tenagobia fuscata (Stål)

(Plate XXXVIII, fig. 7; Plate XXXIX, fig. 11; Plate XL, figs. 8, 9; Plate XLII, fig. 5)

1859. *Sigara fuscata* Stal. Hemiptera. Kongl. Svens. Freg. Eugenies resa omk. Jord. Zool., IV.

1879. *Sigara fuscata* Stal. White, F. B. *Trans. Ent. Soc. London,* XVII: 273. (Probably an erroneous determination.)

1899. *Tenagobia fuscata* (Stal). Bergroth, E. *Ent. Mo. Mag.,* ser. 2, X(35): 282.

1928. *Tenagobia fuscata* (Stal). Lundblad, O. *Ark. f. Zool.,* XXA (7): 4-9.

1930. *Tenagobia fuscata* (Stal). Jaczewski, T. *Mitt. Zool. Staat. u. Zool. Mus. Hamburg,* XLIV: 143.

Size. Length, male, 3.3-3.45 mm.; female, 3.4-3.75 mm. Width of head, male, 1.3-1.4 mm.; female, 1.4 mm.

Color. Rather uniformly fuscous, sometimes shining above; eyes black; front and vertex yellow, except posterior margin, which is black; base of scutellum and tips and lateral margins of hemelytra yellowish, the latter with two dark maculations; transparent V-shaped figure near the base of each clavus. Venter dull grayish fuscous, posterior margins of abdominal segments lighter; legs yellowish, becoming fuscous distally.

Structural Characteristics of Male. Head (Pl. XXXVIII, fig. 7): Median posterior margin of vertex elevated into a tubercle, caudolateral angles of vertex right-angled; an eye about 1¼ times wider than interocular space; a distinct space between the posterior margin of head and eyes. *Prothorax:* Mustache-like bristles present on lateral margins; pronotum narrow, about 8½ times wider than long, nearly twice as wide as base of scutellum, posterior margin not truncate in front of bases of hemelytra, narrowed at ends. *Scutellum:* Broad at base, narrowed abruptly about half way to apex, which is very acutely angled. *Hemelytra:* Exceed abdomen about 0.2 mm.; membranes much reduced; short spine-like setae scattered irregularly over the corium and clavus, few in numbers as compared with other species; distally there are many long, extremely fine setae. Ratio of lengths of pronotum, scutellum and from apex of scutellum to apex of clavus is as 2:4:15. *Wings:* Absent in type specimens according to Lundblad (17), present but short and nonfunctional in specimens from Buenos Aires and Paraguay. This holds true for the females as well as the males. *Abdomen:* 5th, 6th and 7th segments each with 2 short, spine-like setae on either side; the right side of 6th tergite has a diagonal cleft in which there is a row of short setae much as in *T. selecta* (Pl. XXXVIII, fig. 12); 8th segment (Pl. XXXIX, fig. 11) with 3 lateral and 1 terminal spine-like setae on either side, the tergite-lobe as in illustration. *Claspers:* The right (Pl. XL, fig. 9) has a broad base, a narrowed central part which bears a dorsal hump and a narrowed, upturned distal part; the left (Pl. XL, fig. 8) has a strongly chitinized brown projection at the base, the central part is slender and cylindrical and the distal part is greatly expanded into a frail, leaf-like structure which is ornamented with numerous rows of scale-like structures. *Legs:* Front (Pl. XLII, fig. 5) femur with a row of 6-9 spine-like setae on inner side; tarsus as long as tibia with 16-18 bristle-like setae in the lower row, 14-15 setae in inner row, and 3 long hair-like setae in upper row; tarsal claw relatively long and slender. The ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 85:29:34:23.

Cotypes. Montevideo, Uruguay, many specimens (Hj. Kinberg, collected while circumnavigating the globe in 1851-'53) in Riksmuseum, Stockholm 50.

Distribution (Pls. XLIII and XLVI). Paraguay, Argentina (Buenos Aires) and Uruguay.

Collection Data. Argentina: Buenos Aires, 1 male (M. S. Pennington); 1 female, July 26, 1893 (Michaelson); Hudson, Province Buenos Aires, 3 males, 7 females, no other data. Paraguay: Albovena Srojoguasi, 4 males, 9 females, December, 1926 (F. Schade); Villa Rica, 1 female July 16 and 1 female Dec. 5, 1923 (F. Schade). Uruguay: Montevideo, many specimens, 1851-'53 (H. Kinberg), cotypes; 1 female, Aug. 3, 1893 (Michaelson).

The writer has examined all of the known specimens of this species except the cotypes. These were examined by Doctor Hungerford, who compared part of the writer's material with them.

The specimens collected by the Traill Expedition in the Rio Maderia and referred to as *T. fuscata* by White (29) are not in the

Perth Museum and seem to be lost, so it is impossible for the writer to say whether they were correctly identified. However, it is extremely doubtful if *fuscata* occurs that far north.

Comparative Notes. This species seems to be more closely related to *T. hungerfordi, T. melini,* and *T. schadei* than to any of the other species. It can be distinguished from them readily by the shape of the claspers and the number of spine-like setae along the lateral margins of the abdominal segments.

Tenagobia hungerfordi Deay

(Plate XXXIX, figs. 2, 3, 13; Plate XL, figs. 2, 10; Plate XLII, fig. 7)

1930. *Tenagobia hungerfordi* Deay. *Bull. Brook. Ent. Soc.*, XXV (3): 177-179.

Size. Length, male, 2.85 mm.; female, 3.-3.15 mm. Width of head, male, 1.05 mm.; female, 1.2 mm.

Color. Brownish fuscous above; eyes dark; vertex and front grayish transparent; hemelytra with lateral margins lighter and four dark maculations on each; a transparent V-shaped figure at base of each clavus. Yellowish beneath, hind legs darker distally.

Structural Characteristics of Male. Head (Pl. XXXIX, fig. 3). Posterior margin of vertex without median tubercle, caudolateral angles obtuse; an eye slightly narrower than interocular space; posterior margin of eyes widely separated from the posterior margin of the head. *Prothorax:* Mustache-like bristles present on lateral margins (Pl. XXXIX, fig. 13); pronotum about 7 times wider than median length, 4 times wider than posterior margin of vertex, 2 times wider than base of scutellum, posterior margin not truncate in front of bases of hemelytra, narrowed at ends. *Scutellum:* 1½ times wider than long, apex very acutely angled. *Hemelytra:* Membranes well developed, the left transparent; many minute peg-like setae scattered irregularly over the entire hemelytra, numerous fine hair-like setae distally; a deep longitudinal impression near each lateral margin in which there is a row of large setae. Ratio of the lengths of the pronotum, scutellum and from the apex of the scutellum to apex of clavus is as 20:50:120. *Wings:* Present and well developed in both sexes. *Abdomen:* 5th, 6th and 7th segments each with 2 spine-like setae on either side, the 5th and 6th tergites excavated on the right side and projected on the left; 8th segment (Pl. XXXIX, fig. 2) with 1 lateral and 1 terminal spine-like seta on either side; the tergite lobe bears 11 weak hair-like setae, its inner margin sinuate, right half of segment with a slight projection on mesal margin near the caudal end, which bears a tuft of short bristle-like setae. *Claspers:* The left (Pl. XL, fig. 2) with a brown pointed projection near the base, the end upturned and hollow; the right (Pl. XL, fig. 10) has the distal end bent up at nearly right angles to the basal part; ventrally there is a papilla-like projection. This clasper is very similar to the corresponding one in *T. schadei. Legs:* Front (Pl. XLII, fig. 7) with a row of 6 spine-like setae on inner side of femur; tarsus large, longer than tibia, 12 bristle-like setae in lower row, 13 small setae in inner row and 6 long hair-like ones in upper row. Ratio of lengths of femur, tibia, tarsus and tarsal claws of the middle leg is as 155:55:60:45.

Holotype. Male, Corumba, Matto Grosso, Brazil, Dec. 14-22, 1919 (R. G. Harris), in the Cornell University Museum.

Allotype and Paratypes. Nine specimens, all females, as above.

Distribution (Pls. XLIII and XLVI). Bolivia, Brazil (Matto Grosso) and Paraguay.

Collection Data. Bolivia: Province del Sara, 1 female, No. 30, 1912, and 1 female, Dec., 1913 (J. Steinbach). Brazil: Corumba, Matto Grosso, 1 male, 9 females, types, Dec. 14-22, 1919 (R. G. Harris). Paraguay: Villa Rica, 1 male, Jan. 7, 1923, and 1 female, Dec. 15, 1923 (F. Schade).

Comparative Notes. See this same heading under *T. melini.*

Tenagobia melini Lundblad

(Plate XXXIX, fig. 16; Plate XL, figs. 12, 13; XLII, fig. 4)

1928. *Tenagobia melini* Lundblad. *Ark. f. Zool.* Bd. XXA (7): 18-23.

Original Description:

"1. *Halbdecken.* Die Zeichnung erscheint ungewöhnlich deutlich hervortretend. Möglicherweise beruht das darauf, dass das mir vorliegende Exemplar in Alkohol laf und nicht aufgeklebt und getrocknet war. Die Halbdecken sind mit hellen Flecken übersät. Die Marginalarea weist 4 tiefbraune Flecke auf, und die Clavusbass hat den gewöhnlichen, hellen Fleck, der aber hier nicht so deutlich und durchsichtig ist. Mit Ausnahme der vordersten Partie ist das ganze Corium mit zahllosen (mehreren Hunderten) kleinen, dichtstehenden Dornen ausgerüstet. Auch der Clavus trägt solche Dorne. Am Ende der Halbdecken stehen viele, feine Haare. Ein ausgeprägter, heller Membransaum fehlt (jedoch findet sich eine etwas hellere Partie). Die linke Membran ist grösstenteils wasserklar und beide Membranen, wie die Flügel, sind gut entwickelt.

"2. *Antennen.* Von den langen Haaren der Unterkante und der Spitae sind zwei bedeutend länger als die übrigen.

"3. *Prothorax.* Die Gestalt der Epimera ist recht eigenartig, mit hervorragender Spitze (von vorn gesehen). Hier inserieren einige Schnurrbartborsten. In der Seitenkonkavität stehen auch einige Borsten, während sowohl Epimera wie Episterna im übrigen beinahe ganz kahl sind.

"4. *Vorderbein.* Femur mit der gewöhnlichen feinen, basalen Behaarung und unten mit 6 recht langen, in einer Reihe stehenden Dornen. Die Palaklaue ist recht schmal und langgestreckt, gegen Ende breiter. Auch die Pala ist relativ gestreckt. Von Aussenkanthaaren treten etwa 19, von Innenkanthaaren etwa 14 auf. Die Haare beider Gruppen stehen in ungewöhnlich weiten Abständen. Von feinen, langen Haaren finden sich 5 Stück.

"5. *Mittelbein.* Das verhältnis Femur: Tibia: Tarsus: Klauen betragt 85:27:34:17. Die klauen dieser Art sind also sehr kurz. Das Mittelbein ist, wie das ganze Tierchen, ziemlich dunkel, jedoch, so viel ich finden konnte, einfarbig.

"6. *Sechstes Abdominalsegment.* Von den übrigen Arten abweichend. Der Tergit läuft hinten rechts in eine grosse Zunge aus, vor welcher nur wenige, aber starke, reihenförmig angeordnete Borsten stehen. Die Seitenränder des Segments weisen je nur einen einzigen Dorn auf. Länger nach inner inserieren die gewöhnlichen, feinen Haare, die aber keine deutlichen Reihen bilden.

"7. *Siebentes Abdominalsegment.* Die Beborstung des Tergits ist recht reich. Die feinen Haare stehen auch hier nicht reihenförmig. Zwei Dorne befinden sich jederseits am Seitenrande.

"8. *Achtes Abdominalsegment.* Die linke Zunge ist sehr reich behaart, während der Segmentrand ausser dem Enddorn nur noch einen Dorn weit vorn trägt.

"Die Bürstenhaare des Segments sind äusserst zahlreich, besonders am rechten Tergitteil. Sie sind sehr dunkel distal wenig oder nicht verdickt und von ganz eigenartiger Struktur, durch ihre zahlreichen knotenförmigen Anschwellungen leghaft an die bekannten Süsswasseralgen *Lemanea* und *Sacheria* erinnernd.

"Wir finden auch ein Gegenstück zu den bei *signata* vorhandened, von rechts nach inner gerichteten Dornborsten. Sie sind aber hier mehr nach hinten gerichtet, etwa 7 an der Zahl und seitlich gekräuselt, jedoch nicht so stark wie die Bürstenhaare.

"9. *Neuntes Abdominalsegment.* Die hier abgebildete Genitalkapsel ist wenig bemerkenswert. Der weiche, mit Widerhäkchen versehene Penis ist eingefalteter Lage abgebildet. Beim Kochen in Kalilauge schwillt die Spitze keulenförmig an. Die dabei angenommene Gestalt dürfte dem Aussehen des Gliedes in erigiertem Zustande entsprechen.

"10. *Rechter Genitalgriffel.* Die distale Partie ist mit dem basalen unter einer sehr eigentümlichen Knickung vereinigt, so dass die beiden Teile unter annähernd rechtem Winkel ineinander übergehen. Vielleicht sind sie etwas biegsam verbunden.

"11. *Linker Genitalgriffel.* Er ist basal mit einem stark chitinisiertem, braunem Auswuchs versehen. Sein distaler Teil ist nach oben gebogen, löffelförmig und an der Spitze mit der Andeutung einer Netzskulptur.

"*Fundort.* Ein einziges Männchen wurde am 2, November, 1924, bei Manaos, Brasilien, von Doctor Melin gefangen."

Writer's Description: [11]

Size. Length, male, about 3.0 mm.; width of head, male, 1.36 mm.

Color. General color dark; hemelytra mottled with transparent

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[11] This is a translation and rearrangement of the original description together with some additional information which was furnished the writer by Doctor Lundblad through personal correspondence.

spots, base of clavus with clear V-shaped figure, lateral margins each with 4 deep-brown spots, left membrane transparent. Legs uniformly dark.

Structural Characteristics of Male. Head: An eye about four fifths as wide as interocular space; posterior margins of eyes distinctly separated from the posterior margin of head. *Prothorax:* Mustache-like bristles present on lateral margins. *Scutellum:* Very acutely angled at apex. *Hemelytra:* Numerous (several hundred) minute peg-like setae on corium and clavus, many fine hair-like setae near the distal end of hemelytra; membranal sutures not distinct; both membranes well developed. Ratio of lengths of scutellum and from apex of scutellum to apex of clavus is as 80:114. *Wings:* Present and well developed. *Abdomen:* 5th segment with 2 spine-like setae on either side; 6th segment with 1 spine-like seta on either side; posterior margins of 5th and 6th tergites projected on left side and excavated on right; 7th segment with two spine-like setae on either side; 8th segment (Pl. XXXIX, fig. 16) with 1 terminal and 1 lateral spine-like seta on either side; the tergite lobe bears many fine hairs, the right side of segment with a projection on mesal margin near caudal end which bears a tuft of about 7 short bristle-like setae. *Claspers:* The left (Pl. XL, fig. 13) is furnished at base with a strongly chitinized brown projection, the distal part upturned and spoon-shaped; the right (Pl. XL, fig. 12) with the distal part bent up at nearly right angles to the basal part. *Legs:* Front (Pl. XLII, fig. 4) with 6 spine-like setae on inner side; tarsus long, rather slender, longer than tibia, 19 long, bristle-like setae in upper row. Ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 85:27:34:17.

Holotype. Male, Manaos, Brazil, Nov. 2, 1924 (D. Melin), in the collection of Dr. D. Melin, Zoölogical Museum, Upsala, Sweden.

Distribution (Pls. XLIII and XLVI): But one specimen, the holotype, has been taken.

Comparative Notes. This species and *T. schadei* and *hungerfordi* are close to each other in general appearance. *T. schadei* is unique among the species of Tenagobia in that it is the only one which has no minute peg-like setae on the hemelytra. It also differs from the other two species by the fact that it has but 5 spine-like setae on inner side of the fore femur instead of 6, and that the right side of the 8th abdominal segment is free from hairs for a short distance. *T. melini* differs from the other two in that it has but 1 spine-like seta on each lateral margin of 6th abdominal segment instead of 2, and that the tarsal claws of middle legs are shorter when compared to the tibia than in the others. *T. hungerfordi* differs from the other two in that it has but 12 bristle-like setae in lower row on fore tarsus while they have 18 or 19, and in that it has 6 long hair-like setae in upper row of fore tarsus and they each have 5. The claspers of all three species are distinct although the right claspers of *schadei* and *hungerfordi* are practically identical.

Tenagobia schadei Lundblad

(Plate XXXIX, fig. 14; Plate XL, figs. 1, 3)

1928. *Tenagobia schadei* Lundblad. *Ark. f. Zool.* Bd. XXA (7): 23-25.
1933. *Tenagobia schadei* Lundblad. Jaczewski, T. *Ann. Mus. Zool. Polonici.* X (1): 3.

Original Description:

"1. *Halbdecken.* In allen Merkmalen, so auch in den Halbdecken, steht diese Art der vorigen äusserst nahe. Ein gutes Unterscheidungsmerkmal bieten aber die kleinen Dorne der Deckflügel dar, die bei dieser Art vollständig fehlen. Es ist dies ein gutes Beispiel, wie bei verwandten Arten ein gewisses Merkmal sehr verschiedenartig entwickelt sein kann.

"2. *Antennen.* Ganz wie bei *melini.*

"3. *Prothorax.* Ganz mit *melini* übereinstimmend.

"4. *Vorderbein.* Auch im Vorderbein ist die Ubereinstimmung, so weit ich finden kann, vollständig, nur dass die Femurdorne anstatt 6 nur 5 sind. Auch die Klaue ist ähnlich.

"5. *Mittelbein.* Das Verhaltnis Femur: Tibia: Tarsus: Klauen beträgt 82:29:34:19. Auch bei dieser Art sind also die Klauen sehr kurz.

"6. *Sechtes Abdominalsegment.* Die allgemeine Gestalt ist dieselbe, jedoch ist die Tergitzunge rechts weniger stark abgesetzt und das Segment etwas länger. Jederseits stehen 2 anstatt 1 dorn, und die in der Nähe der Zunge befindliche, schräge Borstenreihe fehlt ganz.

"7. *Siebentes Abdominalsegment.* Hier kommen kaum Unterschiede vor.

"8. *Achtes Abdominalsegment.* Stimmt beinahe vollständig mit dem der vorigen Art überein. Der einzige Unterschied, den ich finden kann, bezieht sich auf die Verteilung der Bürstenhaare des rechten Tergitteils, indem zwischen der vorderen und hinteren Gruppe eine breite Partie ganz frei von Borsten bleibt. Bei *melini* sind auch hier Borsten, auch nur kleinere und mehr undicht stehende, vorhanden.

"9. *Neuntes Abdominalsegment.* Wie bei *melini* gebaut.

"10. *Rechter Genitalgriffel.* In den beiden Styli finden wir einige der besten, arttrennenden Merkmale. Der rechte griffel ähnelt sehr demselben Gebilde bei der vorigen Art, aber die buckelige Dorsalauftreibung for der Einschnürung ist nicht so stark ausgeprägt die bei dieser, und ventral findet sich ein deutlicher, dornförmiger kleiner Vorsprung.

"11. *Linker Genitalgriffel.* Hier sind die Unterschiede noch grösser, wenn auch vielleicht in der Tat nicht ganz so gross, wie aus den Figuren hervorzugehen scheint. Wie bei *melini* ist der Endteil weich, mit Andeutung einer retikulierten skulptur (in den Abbildungen nicht hervorgehoben). Bei *schadei* ist aber der Endteil ausserdem sehr deutlich striiert.

"*Fundort.* Zwei Exemplare wurden von F. Schade im Mai, 1925, bei Villa Rica in Paraguay gesammelt."

Writer's Description:[12]

Size. Length, male, 3.1 mm. Width of head, male, 1.33 mm.

Color. The same as that of *T. melini.*

Structural Characteristics of Male. Head: An eye about 4/5 as wide as interocular space, distinctly separated from the posterior margin of head. *Prothorax:* As in *T. melini. Hemelytra:* The minute peg-like setae absolutely missing, otherwise as in *T. melini. Wings:* Present, well developed. *Abdomen:* 6th segment with 2 spine-like setae on each lateral margin, the projection on the left side of the segment somewhat more produced and the whole segment longer than *T. melini;* 7th segment with 2 spine-like setae on each lateral margin; 8th segment (Pl. XXXIX, fig. 14) with 1 lateral and 1 terminal spine-like seta on each margin, numerous fine hair-like setae on tergite lobe, which is slightly different in shape than that of *T. melini;* in the middle of the right side of the segment is a space which is entirely free from hair-like setae. *Claspers:* The left (Pl. XL, fig. 3) with a strongly chitinized brown projection at base and the reticulately sculptured and striated distal end is upturned; the right (Pl. XL, fig. 1) with distal end upturned and with a papilla-like projection on under side. *Legs:* Foreleg with a row of 5 spine-like setae on the inner side of femur, otherwise as in *T. melini.* The ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 82:29:34:19.

Holotype: Male, Villa Rica, Paraguay, May, 1925. (F. Schade) in Museum at Helsingfors, Finland.

Paratype. 1 specimen as above.

Distribution (Pls. XLIII and XLVI): Brazil (Pernambuco) and Paraguay.

Collection Data. Brazil: Beberibe, Pernambuco, 1 female, stream with very slowly running water, and 3 females, in pond, Nov. 30, 1931; 6 males and 6 females, in same pond, Dec. 1, 1931 (W. Roszkowski and St. Feliksiak). These data reported by Jaczewski (13). Paraguay: Villa Rica, 2 males, types, May, 1925 (F. Schade).

The writer has seen none of the above specimens. The type, however, was examined by Dr. H. B. Hungerford.

Comparative Notes. This species is unique in being the only species of Tenagobia which does not have minute peg-like setae on the hemelytra. For further comparative notes see discussion under *T. melini.*

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[12] This is a translation and rearrangement of the original description, together with some additional information which Doctor Lundblad has furnished the writer through personal correspondence.

Tenagobia costaricana Jaczewski

(Plate XXXVIII, fig. 4; Plate XXXIX, fig. 2; Plate XLI, figs. 1, 4; Plate XLII, fig. 11)

1930. *Tenagobia costaricana* Jaczewski. *Mitt. Zool. Staat. u. Zool. Mus. Hamburg*, XLIV: 144. May.

1930. *Tenagobia minuta* Deay. *Bull. Ent. Soc. Brook.*, XXV (3): 171-172. June. (Synonym.)

Size. Length, male,[13] 1.8 mm.; female, 1.8-2.0 mm. Width of head, male, 0.75 mm.; female, 0.78 mm.

Color. Above brownish-yellow, marked with indistinct fuscous irrorations; eyes darker, sometimes crossed with light bands; front transparent yellowish-gray with dark irrorations; scutellum sometimes with indistinct, broken, longitudinal reddish stripes; costal margins of hemelytra each bearing 3 fuscous maculations. Underside of thorax and legs uniformly yellowish-gray; abdomen darker, sometimes fuscous.

Structural Characteristics of Male. Head (Pl. XXXVIII, fig. 4): Posterior margin of vertex with median tubercle, caudolateral angles but little produced laterally; an eye about ¾ as wide as interocular space; posterior margin of eyes approximate the posterior margin of head. *Prothorax:* No mustache-like bristles on lateral margins; pronotum 5 times wider than its median length, 2½ times wider than posterior margin of vertex, 2 times wider than base of scutellum, anterior margin angulate, posterior margin truncate in front of bases of hemelytra and concavely arcuate in front of scutellum. *Scutellum:* Relatively large, approximately twice as long as median length of pronotum, apex very acutely angled. *Hemelytra:* Membranes well-developed, membranal suture in right rather well developed; many minute, peg-like setae scattered irregularly over the clavus and corrium, more on posterior half of right corium than on the left; a distinct longitudinal impression along the costal margin of each corium. Ratio of length of pronotum, scutellum, and from apex of scutellum to apex of clavus is as 21:40:70. *Wings:* Well developed in both sexes. *Abdomen:* 5th segment with 1 spine-like seta on either side; 6th segment with 2 spine-like setae on either side; 7th segment with 4 spine-like setae on either side, a circular patch of minute setae in dextro-cephalic angle of the tergum; 8th segment (Pl. XXXIX, fig. 2) with 3 lateral and 1 terminal spine-like setae on either side, the tergite

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[13] Jaczewski (11) gives the length of the holotype of this species as 1.3 mm.; however, the writer found its length to be 1.8 mm. when measured with a micrometer eyepiece under a magnification of 120 ×.

lobe with 12 hair-like setae, the right half of segment with a bump-like projection on mesal margin near caudal end which bears a tuft of short bristle-like setae. *Claspers:* The left (Pl. XLI, fig. 1) with a membranous, club-like distal end beset with scale-like structures, the basal and connective parts much the stronger; the right (Pl. XLI, fig. 4) of the same texture throughout, apex pointed, the dorsal margin flattened in front of the apex and then curves down to join the base, 5 minute setae on right side. *Legs:* Front (Pl. XLII, fig. 11) with 2 spine-like setae on inner side of setae, tarsus large, as long as tibia, 13 bristle-like setae on lower edge, setae of inner row, except terminal ones, very minute, 5 long hair-like setae in upper row; tarsal claw large, disc-shaped, constricted into a neck at base. The ratio of the lengths of femur, tibia, tarsus and tarsal claws of the middle leg is as 32:12:15:11.

Holotype. Male, Farm Hamburg am Reventazon, Costa Rica, "Einig. Nr. 52," 1927, in the Zoologische Staatsinstitut und Zoologische Museum, Hamburg.

Allotype (Designated in this paper): Female, Boqueron river, Panama, May, 1907 (A. Busck), in the U. S. National Museum.

Paratypes. None.

Distribution (Pls. XLIII and XLIV): Costa Rica, Honduras and Panama.

Collection Data. Costa Rica: Farm Hamburg am Reventazon, 1 male, holotype, 1927, no other data. Honduras: Near Tela, 8 males, July 16, 1933 (F. H. Test). These specimens were taken in a small pool in sand near a small creek which empties into the Tela river two and one half miles from the town of Tela. Altitude 80 to 90 feet. There were many individuals in the pool. Panama: Boqueron river, 4 males, 3 females, May, 1907 (A. Busck). The Boqueron river is an inland stream east of the Canal Zone. It flows into the Pequeni river, which in turn empties into the Rio Chagres.

As Jaczewski described the species from but a single specimen, the writer designates one of the females taken in Panama as *allotype.*

Dr. E. Wagner of the Zoologische Staatsinstitut und Zoologische Museum of Hamburg has been kind enough to send the writer the holotype of this species for examination.

Comparative Notes. See this heading under *T. truncata.*

Tenagobia marmorata Bergroth

1899. *Tenagobia marmorata* Bergroth. *Ent. Monthly Mag.*, ser. 2, X (35): 282.
1928. *Tenagobia marmorata* Bergroth. Lundblad, O. *Ark. f. Zool.* Bd. XXA (7): 3.

Original Description:

"Oblong-ovalis, glabra, nitidula, albido-testacea, fronte notulis nonnullis rubris ornata, scutello maculis duabus parbis basalibus ferrugineis signato, pronoto et hemelytris glaucis, his fusco-marmoratis, area costali albido-testacea, macula media et apicali fusca notata, no venula obliqua basali, margine interno commissuraque clavi albidis, pedum posteriorum femoribus, tibiis articulisque tarsalibus apice nigrinis. Caput laeve, fronte paullo rotundato-prominente, vertice base oculo distincte latiore, prope orbitam interiorem oculorum lineoa longitudinali breve impressula praedito, margine basali medio in tuberculum minutum nigricans elevato. Pronotum laeve, capite perpaullulum latius et distincte brevius, margine antico medio subangulato, margine postico ante basin hemelytrorum truncato, ante scutellum profunde sinuato. Scutellum nonnihil convexum, parte parva apicali deplanatum, base verticis paullo latius, pronoto perpaullo longius. Hemelytra apicem abdominis paullum superantia, fere impunctata, area costali latiuscula, profunde impressa, extus late rotundata, commissura clavi scutello fere domidio longiore. Long., 2 mm. Venezuela."

Original Description (translated by the writer):

"Oblong-oval, smooth, shining, whitish-testaceous, front ornamented with several red marks, scutellum marked with two small basal, iron-gray spots, pronotum and hemelytra glaucus, the latter dark mottled, the costal area whitish-testaceous, a median spot and apex marked with fuscous; oblique basilar veinlets, internal margin and the commissures of clavus whitish; posterior leg with the femur, tibia and tarsal segments black at apex. Head smooth, front somewhat roundly prominent, base of the vertex distinctly wider than an eye, furnished near the interior orbit of the eye with a short impressed longitudinal line, median basal margin elevated into a minute black tubercle. Pronotum smooth, very little wider and distinctly shorter than head, median anterior margin subangulate, posterior margin truncate in front of the base of the hemelytra, deeply sinuated in front of the base of the scutellum. Scutellum not convex, small apical part flattened, base little wider than vertex, very little longer than pronotum. Hemelytra a little longer than apex of the abdomen, closely punctated, costal area expanded, deeply impressed, broadly rounded outwardly, commissures of the clavus fully one half longer than the scutellum. Length, 2 mm."

Although this species is the halotype of the genus it is not known whether the holotype is a male or a female, as the type specimens cannot be found. Bergroth's description contains few references to structural characters, but it seems to the writer that there are enough characters given to distinguish this species from any of the others known. The structural characters of diagnostic value which Bergroth gives are "length, 2 mm.," "median anterior margin of pronotum subangulate, posterior margin truncate in front of bases of hemelytra, deeply sinuated in front of base of scutellum," "scutellum very little longer than pronotum," "claval commissure fully one half longer than scutellum."

Types. Unfortunately all of the type specimens seem to be lost at present. No distributional or habitat data, except that the specimens were taken in Venezuela, are given by Bergroth.

No other species of Tenagobia has been taken in Venezuela, although *T. incerta* has been taken in Trinidad.

Comparative Notes. *T. marmorata* belongs to the "truncata group" of Tenagobia. It may be distinguished from the other species of this group by the shortness of the scutellum, which is but "little longer" than the pronotum.

Tenagobia pulchra Hungerford

(Plate XXXIX, fig. 5; Plate XLI, figs. 2, 5; Plate XLII, fig. 12)

1927. *Tenagobia pulchra* Hungerford. *Proc. Ent. Soc. Wash.* XXIX (8): 189.

Size. Length, male, 2.1-2.2 mm.; female, 2.17-2.25 mm. Width of head, male, 0.8 mm.; female, 0.82 mm.

Color. General color grayish-yellow above and whitish below. Hemelytra with brownish irrorations, lateral margins paler, each with 2 brown maculations.

Structural Characteristics of Male. *Head:* Posterior margin of vertex with a median tubercle, caudolateral angles but little produced laterally; an eye about ¾ as wide as interocular space; posterior margin of eyes narrowly separated from the posterior margin of head. *Prothorax:* No mustache-like bristles present on lateral margins; pronotum a little over 4 times wider than its median length, 2½ times wider than posterior margin of vertex, 2 times wider than base of scutellum, anterior margin angulate, posterior margin truncate in front of bases of hemelytra, concavely arcuate in front of scutellum. *Scutellum:* As wide as long, apex very acutely angled. *Hemelytra:* Membranes well developed in both hemelytra; many minute peg-like setae scattered irregularly over corium and calvus, more on lateral halves. The ratio of the lengths of the pronotum, scutellum and from the apex of scutellum to the apex of clavus is as 6:11:21. *Wings:* Present, well developed in both sexes. *Abdomen:* 5th and 6th segments each with 3 spine-like setae on either side, 7th segment with 4 spine-like setae on either side, 8th segment (Pl. XXXIX, fig. 5) with 3 lateral and 1 terminal spine-like setae on each side, the tergite lobe with 12-13 hair-like setae, right part of segment with a small hump midway on mesal margin, the segment as a whole relatively free from hairs. *Claspers:* The left (Pl. XLI, fig. 2) with the distal part weak and broad but tapering at apex, beset with scale-like structures, the base and central parts much stronger; the right (Pl. XLI, fig. 5) of the same texture throughout, constricted suddenly near distal end, 5 minute setae on the right side. *Legs:* Foreleg (Pl. XLII, fig. 12) with 2 spine-like setae on inner side of femur; tarsus shorter than tibia, 17 bristle-like setae in lower row, 14 setae in inner row and 5 long hair-like setae in upper row. The ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 38:14:18:12.

Holotype. Male, mouth of Rio Mapiri, Rio Beni, Bolivia, September (W. M. Mann, Mulford Biol. Exp. 1921-'22) in U. S. National Museum.

Paratypes. One male and many females taken with the holotype, in the U. S. National Museum and the Francis Huntington Snow Entomological Collection.

Distribution (Pls. XLIII and XLIV): Only the type specimens have been taken.

Comparative Notes. See this heading under *T. truncata.*

Tenagobia truncata Deay

(Plate XXXIX, figs. 1, 15; Plate XLI, fig. 3; Plate XLII, fig. 1)

1930. *Tenagobia truncata* Deay. *Bull. Brook. Ent. Soc.,* XXV (3): 172-174.

Size. Length, male, 2.17 mm.; female, 2.3 mm. Width of head, male, 0.8 mm.; female, 0.9 mm.

Color. Uniformly brownish to fuscous above; front lighter; no maculations on lateral margins of hemelytra, the proximal half dark, bases of hemelytra lighter; scutellum sometimes with lighter longitudinal lines. Venter fuscous; legs uniformly yellowish-gray.

Structural Characteristics of Male. Head (Pl. XXXIX, fig. 1): Posterior margin of vertex with minute median tubercle, caudolateral angles but little produced laterally; an eye about 4/5 as wide as interocular space; posterior margin of eyes narrowly separated from the posterior margin of head. *Prothorax:* No mustache-like bristles on lateral margins; pronotum 5 times wider than median length, maximum width a little greater than base of head, nearly 3 times wider than scutellum, anterior margin angulate, posterior margin truncate in front of bases of hemelytra and concavely arcuate in front of scutellum. *Scutellum:* Approximately twice as long as median length of pronotum, apex very acutely angled. *Heme-*

lytra: Membranes in both sexes well developed, membranal suture distinct in right hemelytron; many peg-like setae scattered irregularly over the corium and clavus, more numerous along the longitudinal impression along the lateral margin of each corium. The ratio of lengths of pronotum, scutellum and from apex of scutellum to apex of clavus is as 28:55:80. *Wings:* Well developed in both sexes. *Abdomen:* 5th segment with 3 short spine-like setae on either side; the 6th and 7th segments each with 4 spine-like setae on either side, the 7th with a patch of minute setae in dextrocephalic angle of tergum; 8th segment (Pl. XXXIX, fig. 15) with 3 lateral and 1 terminal spine-like setae, the tergite lobe with 10 hair-like setae, the right half of segment with a hump-like projection on mesal margin near caudal end, which bears a tuft of short bristle-like setae. The 8th segment is much smaller in this species than it is in either *costariciana or pulchra. Claspers:* The left (Pl. XXXIX, fig. 3) membranous distally and rather spoon-shaped (the drawing is of the lateral aspect), beset with minute scale-like structures on its right face, basal and connective parts stronger; the right resembles that of *costaricana* and *pulchra,* its apex roundingly pointed and sloping gradually from the apex to the base, 6 minute setae on right side. *Legs:* Front (Pl. XLII, fig. 1) slender, femur with two spines on inner side, tarsus noticeably shorter than tibia, 14 bristle-like setae in lower row, 11 weak setae in inner row, 4 long hair-like setae in upper row, tarsal claw large, disc-shaped. Ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 32:-10:15:9.

Holotype. Male, Tena near Oriente, Ecuador, March 29-April 10, 1923 (F. X. Williams), in the Francis Huntington Snow Entomological Collection.

Allotype. As above.

Paratypes. 1 male and 3 females as above.

Distribution (Pls. XLIII and XLIV): Only the type specimens have been taken.

Comparative Notes. This species and the preceding three, *costaricana, marmorata* and *pulchra* form the *truncata* group of Group I, being characterized by having the pronotum truncate in front of the base of the hemelytra. The localities in which the different species have been collected are distant from each other (Pl. XLV), and each, with the exception of *costaricana,* has been taken but once. Other species that belong to this group will undoubtedly be found when more intensive collections have been made; in fact, the writer has specimens of females of this group which are without doubt distinct from the known species.

Of the four species known, *marmorata* is unsatisfactorily described; but as pointed out under the discussion of that species, Bergroth states that the scutellum is very little longer than the pronotum ("pronoto perpaullo longius") and this distinguishes it from the other three species. The remaining three species are more distinct that the preceding descriptions possibly indicate. *T. truncata* is not as robust as the other two, its legs being much more slender and the abdominal segments, especially the eighth, much smaller. Aside from the claspers, *costaricana* is probably best distinguished from the other two by the fact that the fore tarsus is as long as the fore tibia; and *truncata* from *pulchra* by the shape of the eighth abdominal segment, particularly of the tergite lobe and by the fact that the sixth abdominal segment bears three spine-like setae on each lateral margin in *pulchra* and four in *truncata*.

Tenagobia signata White

(Plate XXXIX, fig. 7; Plate XLI, figs. 8, 12)

1879. *Sigara signata* White. *Trans. Ent. Soc. London,* XVII: 274.

1879. *Sigara socialis* var. *sobrina* White. *Trans. Ent. Soc. London,* XVII: 275. (Orig. descrip. of synonym.)

1879. *Sigara seducta* White. *Trans. Ent. Soc. London,* XVII: 275. (Orig. descrip. synonym.)

1879. *Sigara simulans* White. *Trans. Ent. Soc. London,* XVII: 276. (Orig. descrip. of synonym.)

1928. *Tenagobia signata* (White). Lundblad, O. *Ark. f. Zool.* Bd. XXA (7): 13-16.

1930. *Tenagobia signata* (White). Jaczewski, T. *Mitt. Zool. Staat. u. Zool. Mus. Hamburg,* XLIV: 143-144. (Mistaken identity.)

1931. *Tenagobia signata* (White). Jaczewski, T. *Ann. Mus. Zool. Polonici,* IX (15): 233. (Mistaken identity.)

Size. Length, male, 2.4-2.8 mm.; female, 2.6-3.0 mm.; width of head, male, 0.95 mm.; female, 1.0 mm.

Color. Varies from grayish or yellowish to brownish fuscous above, sometimes uniformly colored, but commonly with alternate lighter and darker wavy longitudinal striations which give a marbled appearance to the hemelytra, rarely with broken and irregular orange-red lines on vertex, pronotum, scutellum and hemelytra; lateral margins of hemelytra each with four dark maculations, a transparent V-shaped figure near base of each clavus, a slender, transparent longitudinal line in right hemelytron caudal to claval suture, distal end of left hemelytron transparent. Venter and legs vary from grayish white to grayish fuscous.

Structural Characteristics of Male. Head: Posterior margin of vertex with a minute median tubercle, caudolateral angles produced laterally; an eye about six sevenths times as wide as interocular space; distinct, though narrow, space between the posterior margin of eyes and posterior margin of head. *Prothorax:* No mustache-like bristles on lateral margins; pronotum about 5 times wider than median length, about 2½ times wider than posterior margin of vertex, about 1.6 times wider than base of scutellum, posterior margin not truncate in front of bases of hemelytra, narrowed at ends. *Scutellum:* About 2½ times wider at base than length, a little over twice as long as pronotum. *Hemelytra:* Exceeds abdomen slightly, membranal suture distinct in right hemelytron, but not in left; minute peg-like setae scattered irregularly over the outer half of the corium, those on lateral margins arranged in longitudinal rows, impressed line on outer half of corium forming an embolium. Ratio of lengths of pronotum, scutellum, and from apex of scutellum to apex of clavus is as 18:40:70. *Wings:* Present in both sexes. *Abdomen:* 5th, 6th and 7th segments each with 2 short spine-like setae on either side, 8th segment with one terminal and 3 lateral spine-like setae on either side, the tergite lobe (Pl. XXXIX, fig. 7) with a few weak hair-like setae, the right half of segment with a hump-like projection on the mesal margin near the caudal end from which arises a tuft of short bristles. *Claspers:* The right (Pl. XLI, fig. 12) serrate ventrally, the heel right angled, toe slightly produced, broadly rounded at apex; the left (Pl. XLI, fig. 8) rather simple, heel not developed, toe sharply pointed. *Legs:* Front, femur with a stiff spur which arises from a papilla-like projection on the lower side (Pl. XLII, figs. 2, 3); above this on the inner side is a row of 4 spine-like setae; tarsus shorter than tibia, 16-17 bristle-like setae in the lower row, 14-16 short setae in inner row, 10-11 long hair-like setae in upper row; tarsal claw short and broad except at distal end where it is suddenly constricted. The ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg is as 60:19:-25:20. The tarsal claw of hind leg is 3-pronged, one being very short, and the one of medium length being over three fourths as long as the longest.

Cotypes. Dio Purus, Brazil, 9 specimens, November, 1873 (J. W. H. Traill), in Perth Museum, Perth, Scotland, and British Museum (Natural History).

Synonyms. As pointed out in the general discussion on synonymy, *socialis* var. *sobrina* (White), *seducta* (White) and *simulans* (White) are all synonyms of *T. signata.* The writer also pointed out at that time that on account of their geographical distribution that he believes the specimens of *T. socialis* collected by Doctor Traill at Anana, Upper Amazon, November, 1874, and at Urubu Caxoeira, November, 1874, belong to *signata*.

Distribution (Pls. XLIII and XLV). Brazil: Rio Jurua, Rio Purus, Tonantins, Upper Amazon.

Collection Data. Rio Purus, 9 specimens, November, 1873 (J. W. H. Traill), type locality; Rio Jurua, "many specimens at light" October and November, 1874 (J. W. H. Traill), *seducta;* Urucaca, Rio Jurua, "many specimens" (J. W. H. Traill), *socialis* var. *sobrina;* Upper Amazon, October 13, and Tonantins, December 12, 1874, 3 females (J. W. H. Traill), *simulans.*

The writer, through the kindness of Dr. W. E. China, has examined specimens of the cotypes and all of the synonyms.

Lundblad (17) refers some female specimens collected by Ramon in the Rio Autaz, near Manaos to *signata,* but they are probably specimens of *incerta* or *socialis.* The writer has examined many specimens of the *signata* group which have been collected on the Amazon from Manaos to its mouth, but no *T. signata* specimens have been among them. In fact, no specimens of this species have been taken since Traill's Expedition in 1873-'75, but on the other hand, no collections of Tenagobia have been made in the Upper Amazon, Jurua and Purus rivers since that time. The fact that *signata* has not appeared in the collections that have been made since the above expedition is a good indication that this species is restricted to that region.

The specimens in the Zoologische Staatsinstitut und Zoologische Museum of Hamburg which were referred to *signata* by Jaczewski (11) belong to *socialis* and *mexicana.* That is, the specimens from Paramaribo, Dutch Guiana, are *socialis,* and those from Mexico are *mexicana.*

Comparative Notes. As stated previously in this paper under the heading "groups within the genus," *signata, socialis, incerta, mexicana* and *serrata* compose a group of very similar species which the writer (3) has designated as the *signata* group. The females of this group are practically indistinguishable from each other, but the males exhibit definite, constant characters which are specific. For this reason, and because of the distribution of these species, the writer believes them to be distinct species. Lundblad (17) reduced *socialis* to a variety of *signata* and described *incerta* as a variety of it. The other two species of the group had not been described at that time. The species can be easily distinguished from each other by the shape of the male claspers. An idea of the differences in these claspers can be obtained more clearly by studying the illustrations in Plate XLI than from a verbal description of them. Both claspers of *mexicana* (figs. 6, 13) are distinct; the left claspers of *signata* (fig. 8) and *serrata* (fig. 7) are very similar, and that of *incerta* (fig. 10) resembles them, but the right claspers of these three species (figs. 12, 15, 11) are very distinct; on the other hand, the right claspers of *socialis* (fig. 14) and *serrata* (fig. 15) are somewhat alike, but the left claspers of these two species (figs. 7, 9) are distinct.

Tenagobia incerta Lundblad

(Plate XLI, figs. 10, 11)

1928. *Tenagobia signata* var. *incerta* Lundblad. *Ark. f. Zool.* Bd. XXA (7): 16-18.

1894. *Sigara socialis* White. Uhler, P. R. *Proc. Zoöl. Soc. London:* 224. (Mistaken identity.)

1933. *Tenagobia signata* var. *incerta* Lundblad. Jaczewski, *T. Ann. Mus. Zool. Polonici,* X (1): 2-3.

Size. Length, male, 2.55-2.8 mm.; female, 2.85-3.0 mm. Width of head, male, 1.0 mm.; female, 1.1 mm.

Color. As in *T. signata.*

Structural Characteristics of Male. Head: As in *signata* except an eye is but three fourths as wide as interocular space, and caudolateral angles of vertex are nearly right angles. *Prothorax:* As in *signata;* pronotum about 5½ times its median length, and about 1.8 times wider than the base of scutellum. *Scutellum:* About 3 times longer than median length of pronotum. *Hemelytra:* As in *signata.* Ratio of lengths of pronotum, scutellum and from apex of scutellum to apex of clavus is as 2:6:10. *Wings:* Present in both sexes. *Abdomen:* As in signata. *Claspers:* The right (Pl. XLI, fig. 11) is not noticeably serrate ventrally, heel acute, much produced, ventral margin of clasper excavated immediately proximad to it, toe narrowed and produced; the left (Pl. XLI, fig. 10) is rather simple, resembling that of *signata* and *serrata,* but toe is not produced and is rounded. *Legs:* As in *signata* except the fore tarsus has 14-15 bristle-like setae in lower row, 14-15 small setae in inner row and only 6-7 long hair-like setae in upper row; the middle-sized prong of the hind tarsal claw is only one-half as long as the longest.

Holotype. Male, Villa Rica, Paraguay, May, 1925 (F. Schade), in Museum at Helsingfors, Finland.

Allotype and *Paratypes.* As above.

Distribution (Pls. XLIII and XLV): Bolivia, Brazil (Amazonas, Matto Grosso, Minas Geraes, Para), Grenada, Paraguay, Peru, Trinidad.

Collection Data. Bolivia: Province del Sara, 2 females, Nov. 30, 1912 (J. Steinbach), 1 male, 2 females, Feb., 1913 (J. Steinbach), 1 male, 15 females, Dec., 1918 (J. Steinbach); Puerto Saurez, 2 females, alt. 500 feet (J. Steinbach); Rio Mapiri (W. M. Mann, Mulford Biol. Exp. 1921-'22); Santa Cruz de la Sierra, 1 male, 4 females, alt. 1,350 feet, Nov., 1910 (J. Steinbach).

Brazil: Manacapura, Solimoes river, Amazonas, 2 males, 2 females, June, 1926 (S. M. Klages); Corumba, Matto Grosso, 57 males, 84 females, Dec. 14 to 22, 1919 (R. G. Harris); Lassance, Minas Geraes, 11 males, 32 females, Nov. 9, 1919 (R. G. Harris); Piropara, Minas Geraes, 22 males, 44 females, Nov. 11, 12, 1919 (R. G. Harris); Para (Belem), 1 male, 2 females, Dec. 6, 1907; Pernambuco[14] (Recife), westwards of Olinda, a fresh-water pool on a roadside, 8 females, 1 nymph, Nov. 28, 1931 (Roszkowski and St. Feliksiak); Pernambuco, near Boa Viagem, large pool, 3 males, 1 female, 2 nymphs, Nov. 29, 1931 (Roszkowski and St. Feliksiak).

Grenada, Lesser Antilles: Woburn, 2 males, 4 females, no date, labeled P. R. Uhler Collection (Sauter and Smith); Woburn, 2 males and 3 females in U. S. National Museum collection, one of which is labeled P. R. Uhler Collection, no date (H. H. Smith). Uhler (26) says "Nearly two dozen specimens of this species, including some varieties in size and color, were collected on most parts of the island. At Balthazar it was found July 11, flying at sunset after a heavy rain. On the Mount Gay and Telescope estates it was taken in August from spring water; but at Woburn it was more common, August 30, in a sluggish stream in the open country near sealevel."

Paraguay: Villa Morra, Asuncion, 4 males and 6 females, no date (Vezenyi);[15] Caraveni, 3 males, 8 females, April 15, and 1 female, Oct. 30, 1924 (F. Schade); Molinasque, 1 male, 9 females, June 20, and 16 males, 28 female, Oct. 22, 1925 (F. Schade); Villa Rica, 1 female, Dec. 6, 6 females, July 3, and 2 females, July 16, 1923 (F. Schade); 9 males, 23 females, Feb. 21, 1924 (F. Schade); 2 females, Jan. 15, and the type specimens, May, 1925 (F. Schade).

Peru: Puerto Bermudez, Rio Pichis, 1 male, 2 females, July 12 to 19, 1920 (Cornell Univ. Exp.).

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[14] The Pernambuco records are reported by Jaczewski (13). The writer has not seen these specimens.

[15] This part of a long series which is deposited in the Museum at Budapest.

Trinidad: Prince Town, 2 specimens at light, Dec. 13, 1928 (J. G. Myers).

The writer has examined all of the material, about 350 specimens, mentioned above except the types and those reported by Jaczewski. The types were examined by Doctor Hungerford, who compared part of the writer's material with them. Doctor Lundblad has kindly informed the writer as to the disposition of the types, a matter not mentioned in the original description.

On the basis of our present knowledge of the distribution of the genus, this species is more widely distributed than any of the others. It has been taken from Grenada, Lesser Antilles on the north to Villa Rica, Paraguay, on the south, and from Puerto Bermudez, Peru, on the west to Pernambuco, Brazil, on the east.

Comparative Notes. See this same heading under *T. signata.*

Tenagobia mexicana Deay

(Plate XXXVIII, fig. 5; Plate XLI, figs. 6, 11; Plate XLII, fig. 3)

1930. *Tenagobia mexicana* Deay. *Bull. Brook. Ent. Soc.*, XXV (3): 174-175.

1894. *Sigara socialis* White (in part). Uhler, P. R. *Proc. Zoöl. Soc. London:* p. 224.

1901. *Tenagobia socialis* (White). Champion, G. C. *Biol. Cent. Amer.,* Hemip.-Heter. II: 383.

1930. *Tenagobia signota* (White) (in part). Jaczewski, T. *Mitt. Zool. u. Zool. Mus. Hamburg*, XLIV: 143-144.

1931. *Tenagobia signata* (White). Jaczewski, T. *Ann. Mus. Zool. Polonici,* IX (15): 223.

1931. *Tenagobia socialis* (White). Jaczewski, T. *Ann. Mus. Zool. Polonici,* IX (15): 223.

1931. *Tenagobia mexicana* Deay. Jaczewski, T. *Ann. Mus. Zool. Polonici,* IX (15): 223.

Size. Length, male, 2.55-2.7 mm.; female, 2.85-3.0 mm. Width of head, male, 0.97-1.0 mm.; female, 1.12-1.17 mm.

Color. As in *signata.*

Structural Characteristics of Male. Head: As in *signata,* but with caudolateral angles of vertex less acute and an eye 4/5 as wide as interocular space. The space between the posterior margin of eyes and the posterior margin of head greater than in the other species of the *signata* group, but this character is variable. *Prothorax:* As in *signata*; pronotum 6 times wider than median length. *Scutellum:* 1⅓ times wider than long. *Hemelytra:* As in *signata.* Ratio of lengths of pronotum, scutellum, and from apex of scutellum to apex of clavus is as 2:6:11. *Wings:* Present and well developed in both sexes. *Abdomen:* As in *signata. Claspers:* The right (Pl. XLI, fig. 13) not serrate ventrally, the heel acute, caudal margin deeply excavated, toe much produced and rounded at apex; the left (Pl. XLI, fig. 6) very striking, the distal part somewhat hammer-shaped, the heel and toe both acutely angled and much produced. *Legs:* Front (Pl. XLII, fig. 3) the same as in *signata* except for the number of setae on the tarsus, there being 14-15 bristle-like setae in the lower row, 15-17 small setae in the inner row, and 8 long hair-like setae in the upper row. The middle leg as in *signata*. The tarsal claw of hind leg (Pl. XXXVIII, fig. 5) as in *signata*.

Holotype. Male, Nainari, Sonora, Mexico, August 19, 1927 (A. Dampf), in the Francis Huntington Snow Entomological Collection.

Allotype. As above.

Paratypes. Thirty-eight males, sixty females, as above.

Distribution (Pl. XLIII): California (?) (*socialis* specimens reported by Uhler), Guatemala, Mexico (Chiapas, Guerrero, Morelos, Nayarit, Sinaloa, Sonora, Tabasco, Tamaulipas, Tepic, Vera Cruz), Panama.

Collection Data. Guatemala: Paso Antonio, 2 males, 4 females, altitude 44 feet, Feb. 19-28, 1881 (G. C. Champion).

Mexico: Huixtla, Chiapas, 7 specimens taken at light in hotel room, altitude about 135 feet, and 76 specimens taken at trap light on shores of Huixtla river ("The bed of the river is filled with boulders and gravel, the current is swift and there are small cataracts. Huixtla is nearly thirty kilometers from the sea (Pacific) immediately where the Sierra Madre begins to arise"—from notes accompanying the specimens), Nov. 21, 1930 (A. Dampf); Tlapahuala, Guerrero, 2 females at lights on shore of Balsas river, altitude about 660 feet, Aug. 23, 1930 (Public Health Inspector of Mexico); Cuernavaca, Morelos, 1 female, March 5, 1928 (A. Dampf); Acaponeta, Nayarit, 1 male, Nov. 2, 1923 (J. H. Williamson); Presidio de Mazatlan, Sinaloa, 1 female (A. Forrer); Nainari, Sonora, types, at light at house of General Obregon, near Yaqui river, Aug. 19, 1927 (A. Dampf); Teapa, Tabasco, 2 females, 1888 (H. H. Smith); El Mante, Tamaulipas, 1 male, 2 females, at light, altitude about 330 feet, Oct. 26, 1930 (A. Dampf); Hac de Ixtapa, Tepic, 2 males, 3 females, 1908 (P. Hacker); Santa Lucrecia, Vera Cruz, 16 males, 34 females, Nov. 9, 1930 (A. Dampf); Cardel, Vera Cruz, 9,872 specimens, at light on shore of Rio San Francisco, August, 1932 (R. Soto).

Panama: David, 1 female, 1881 (G. C. Champion).

The writer has examined all of the above specimens.

Uhler (25) says that *T. socialis* occurs in California. The writer has been unable to locate any specimens of Tenagobia which have been taken in California, although he has seen several specimens of Tenagobia which were in Uhler's collection. These had, however, all been taken on the Island of Grenada. It seems logical that the

California specimens to which Uhler referred were specimens of *mexicana*, since it is the only species of Tenagobia known to occur north of Central America.

The specimens of *T. mexicana* collected by P. Hacker at Hac de Ixtapa, Tepic, and deposited in the Zoologische Staatsinstitut und Zoologische Museum at Hamburg were misidentified by Jaczewski (10) as *signata*.

The specimens collected by Forrer, Smith and Champion and deposited in the British Museum (Natural History) are the ones referred to as *T. socialis* in "Biologia Centrali Americana."

Comparative Notes. See this heading under *T. signata*.

Tenagobia serrata Deay

(Plate XLI, figs. 7, 15)

1930. *Tenagobia serrata* Deay. *Bull. Brook. Ent. Soc.*, XXV (3): 175-176.

Size. Length, male, 2.55 mm.; female, 3.0-3.1 mm. Width of head, male, 1.0 mm.; female, 1.2 mm.

Color. Much as in *T. signata*, except that the legs are uniform yellow in the specimens known.

Structural Characteristics of Male. Head: As in *T. signata* except that an eye is about four fifths as wide as interocular space and caudolateral angles of vertex are more acute. *Prothorax:* As in *signata*. *Scutellum:* 2½ times wider than long. *Hemelytra:* As in *signata*. Ratio of lengths of pronotum, scutellum and from apex of scutellum to apex of clavus is as 6:15:30. *Wings:* Present in both sexes. *Abdomen:* As in *signata*. *Claspers:* The right (Pl. XLI, fig. 15) with a double row of serratures ventrally, the heel very acute, a deep excavation immediately proximad to it, the toe somewhat produced and rounded; the left (Pl. XLI, fig. 7) rather simple, heel not developed, toe pointed, resembles that of *signata* closely. *Legs:* As in *signata*.

Holotype. Male, Lower Mamore river, December, 1913 (J. Steinbach), in the Carnegie Museum.

Allotype and *Paratypes*. Eight females, as above.

Distribution (Pls. XLI and XLV): Only the type specimens have been taken.

Comparative Notes. See under *T. signata*. This species seems to be between *signata* and *socialis*, the right clasper resembling that of *socialis* and the left that of *signata*.

Tenagobia socialis (White)

(Plate XLI, figs. 9, 14; Plate XLII, fig. 2)

1879. *Sigara socialis* White. *Trans. Ent. Soc. London,* XVII: 274-275.

1894. *Sigara socialis* White. Uhler, P. R. *Proc. Zoöl. Soc. London:* 224. (Mistaken identity.)

1901. *Tenagobia socialis* (White). Champion, G. C. *Biol. Cent. Amer.* Hemip.-Heter. II: 383. (Mistaken identity.)

1928. *Tenagobia signata* var. *socialis* (White). Lundblad, O. *Ark. f. Zoöl.* Bd. XXA (7): 16.

1930. *Tenagobia signata* (White) (in part). Jaczewski, T. *Mitt. Zool. Staats. u. Zool. Mus. Hamburg,* XLIV: 143-144.

1931. *Tenagobia socialis* (White). Jaczewski, T. *Ann. Mus. Zool. Polonici,* IX: 223. (Mistaken identity.)

Size. Length male, 2.25-275 mm.; female, 2.6-2.9 mm. Width of head, male, 1.0 mm.; female, 1.2 mm.

Structural Characteristics of Male. Head: About the same as in *signata* except that the vertex is wider in proportion to the total width of head, an eye being about three fourths as wide as interocular space, and the caudolateral angles of the vertex are more produced laterally. *Prothorax:* As in *signata;* pronotum 6 times wider than median length, about 1.7 times wider than base of scutellum. *Hemelytra:* As in *signata.* Ratio of lengths of pronotum, scutellum and from apex of scutellum to apex of clavus is as 2:6:10. *Wings:* Present in both sexes. *Abdomen:* As in *signata. Claspers:* The right (Pl. XLI, fig. 14) serrate ventrally, the heel acute, much produced, toe rounded; the left (Pl. XLI, fig. 9) differing from all others in the *signata* group in the shape of the distal end. *Legs:* As in *signata* except that there are only 6-7 long hair-like setae on the fore tarsus (Pl. XLII, fig. 2).

Cotypes. Rio Maderia up to Sao Antonio da Boa Vista, June, 1874; Rio Trombetas, March, 1875, and Manoas, Brazil, August, 1875 (J. W. H. Traill), in Perth Museum, Perth, Scotland, and British Museum (Natural History). White also gives Anana, Upper Amazon, Sept., 1874, and Urubu Caxoeira, Rio Jurus, Nov., 1874 (J. W. H. Traill), as type localities.

Distribution (Pls. XLI and XLV): Brazil (Manaos, Rio Maderia, Rio Trombetas, Santarem), British Guiana, Dutch Guiana.

Collection Data. Brazil: Manaos, cotypes, Aug., 1875 (J. W. H. Traill); Rio Maderia up to Sao Antonio da Boa Vista, cotypes, June, 1874 (J. W. H. Traill); Rio Trombetas, cotypes, March, 1875 (J. W. H. Traill); Santarem, 7 males, 15 females, Dec. 10-11, 1909.

British Guiana: East Coast Demerara river, July 20, 1932, Aug. 2, 1932, Aug. 25, 1932 (S. Harris); Lamaha Conservancy, east coast, Demerara river, 26 males and 32 females, Aug. 2, 1932 (S. Harris); Canal Polder No. 2, west bank, Demerara river, 4 males and 22 females, Aug. 25, 1932 (S. Harris); Georgetown, 13 males, 25 females, at light on Middle street, Jan. 27, 1927 (L. D. Cleare, Jr.); Koriabo, Barima river, 1 female, at light, May 5, 1929 (J. G. Myers); Tumatumari, 7 males and 12 females, July 19, 1923 (F. X. Williams).

Dutch Guiana: Cottica, Para District, several specimens, no other data; Paramaribo, many specimens, both male and female, no date (C. Heller).

White (29) says of the cotypes, "Many specimens taken at light, etc." The writer has examined 5 male and 3 female cotypes from Manaos. He examined none from the Trombetas river, but he has examined specimens from Santarem, which is within a hundred miles of the Trombetas. All of the other material mentioned under "Collection data" has been examined by the writer. White (29) also places the specimens taken by Traill at Anana, Upper Amazon and at Urubu Caxoeira, Rio Jurua, in this species. The writer has not seen any of these specimens, but believes that since they were taken at the same time and in the same localities as the cotypes of *signata* that they belong to that species.

The *socialis* specimens mentioned by Champion (2) are *mexicana*. The specimens collected by Heller at Paramaribo, Dutch Guiana, and deposited in the Zoolgische Staatsinstitut und Zoologischen Museum at Hamburg were misidentified as *signata* by Jaczewski (11). The specimens collected in Grenada and referred to this species by Uhler (26) belong to *incerta*.

Lundbald (17) reduced *socialis* to a variety, but as stated elsewhere, the writer believes it to be of specific rank.

Comparative Notes. See this heading under *T. signata*.

Tenagobia selecta (White)

(Plate XXXVIII, figs. 1, 2, 3, 6, 9, 11, 12; Plate II, figs. 9, 17-22; Plate XL, figs. 11, 14; Plate XLII, fig. 10)

1879. *Sigara selecta* White. *Trans. Ent. Soc. London,* XVII: 273.

1927. *Tenagobia selecta* (White). Hungerford, H. B. *Proc. Ent. Soc. Wash.,* XXIX (8): 189.

1928. *Tenagobia selecta* (White). Lundblad, O. *Ark. f. Zool.,* XXA (7): 9-13.

Size. Length, male, 4.2-4.6 mm.; female, 4.4-4.8 mm. Width of head, male, 1.6-1.8 mm.; female, 1.7-1.9 mm.

Color. Varies from a unifrom light brown to a mottled dark brown above; front and vertex usually yellowish transparent, the yellow more noticeable in the darker individuals; lateral margins of hemelytra lighter, each with two large deep brown maculations, a transparent V-shaped figure near the base of each clavus, the membranal suture of right hemelytron transparent. Ventral aspect of thorax yellowish, of the abdomen darker; legs and antennae yellowish.

Structural Characteristics of Male. Head (Pl. XXXVII, fig. 2, Pl. XXXIX, fig. 22): Posterior margin of the vertex right angled; an eye about 1¼ times wider than interocular space; posterior margin of the eyes distinctly separated from the posterior margin of the head. *Prothorax* (Pl. XXXIX, fig. 17): No mustache-like bristles on lateral margins; pronotum very short, 7 times wider than median length, posterior margin not truncate in front of bases of hemelytra, narrowed at ends. *Scutellum:* Varies in size according to the extent that the wings are developed; in winged specimens it is twice as long and wide as in the wingless ones. *Hemelytra:* Membrane well developed in winged individuals and much reduced in wingless ones of both sexes, the right membranal suture distinct; many minute peg-like setae scattered irregularly over entire hemelytra; numerous extremely long, fine setae distally; a deep longitudinal furrow near each lateral margin in which there is a row of fairly large setae. Ratio of lengths of pronotum, scutellum and from apex of scutellum to apex of clavus varies according to the development of the wings; in wingless forms it is as 11:22:113; in individuals with small functionless wings it is as 11:38:115; in winged forms it is as 11:45:105. *Wings:* Present, absent, or small and useless for flight. This is true for both sexes. *Abdomen* (Pl. XXXVIII, figs. 9, 12): 5th segment with 1 short spine-like seta on either side; 6th and 7th segments each with 3 short spine-like setae on either side, the right side of 6th tergite with a diagonal cleft along which is a row of short setae; 8th segment with four lateral and 1 terminal spine-like setae on either side; the tergite lobe is strikingly different from that of the other species, being elongated into a finger-like process, the caudal margin with a brush of hair-like setae gradually elongated from left to right. *Claspers:* The left (Pl. XL, fig. 11) is divided into three distinct regions, a strong, brown basal part, a shaft-like central part and a greatly expanded, leaf-like, transparent, distal part which is beset with numerous papillae; the right (Pl. XL, fig. 14) with a broad base, a slender middle part which has a dorsal hump toward the distal end, and an enlarged distal part, constricted between middle and distal parts. *Legs:* Foreleg (Pl. XLIII, fig. 10) with a row of from 7-9 spine-like setae on lower side of femur; tarsus large, nearly twice the length of tibia, 16-18 bristle-like setae on lower margin, 12-15 setae in inner row, 5-13 long hair-like setae in upper row. Ratio of lengths of femur, tibia, tarsus and tarsal claws of middle leg (Pl. XXXVIII, fig. 11) is as 123:38:52:27. Tarsal claw of hind leg (Pl. XXXVIII, figs. 3, 6) two-pronged.

Cotypes. Manaos, Brazil, "many specimens," "at light," August, 1875 (J. W. H. Traill) in the Perth Museum, Perth, Scotland, and the British Museum (Natural History).

Distribution (Pls. XLIII and XLIV): Bolivia, Brazil (Manacapura, Manaos, Rio Autaz), Paraguay.

Collection Data. Bolivia: Ivon Beni, 24 specimens, February (W. M. Mann, Mulford Biol. Exp. 1921-22). All of these specimens have well-developed wings.

Brazil: Manacapura, Amazonas, 85 males, 111 females, June, 1926, and 40 females, March, 1928 (S. M. Klages); Manaos, many specimens, at light, August, 1875 (J. W. H. Traill), cotypes; Rio Autaz (near Manaos), October, 1924 [A. Roman, reported by Lundblad (17)]. The specimens collected by Klages are either wingless or with very small wings; the cotypes are winged.

Paraguay: Villa Rica, August, 1926 (F. Schade). This is the first time that *selecta* has been reported from Paraguay and this record extends its known range over a thousand miles.

The writer has examined 6 of the cotypes and all of the other material known except the specimens taken by Roman in the Rio Autaz.

Comparative Notes. T. selecta is the largest of the known species of Tenagobia. It belongs to the group which is characterized by the absence of mustache-like bristles on the lateral margin of the prothorax, but it does not seem to be close to any of the other species of this group. It can be easily distinguished from the other species of the genus by the tergite lobe of the 8th abdominal segment (Pl. XXXVIII, fig. 12).

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PLATE XXXVIII

FIG. 1. Tibia-tarsus, foreleg, female, *T. selecta* (White).
FIG. 2. Head, male, *T. selecta* (White).
FIG. 3. Hind tarsal claw, male, *T. selecta* (White).
FIG. 4. Dorsal aspect, *T. costaricana* Jaczewski.
FIG. 5. Hind tarsal claw, male, *T. mexicana* Deay.
FIG. 6. Hind leg, male, *T. selecta* (White).
FIG. 7. Dorsal aspect, male, *T. fuscata* (Stal).
FIG. 8. Dorsal aspect, male, *Micronecta pronuba* Distant.
FIG. 9. Ventral aspect of abdomen, male, *T. selecta* (White).
FIG. 10. Dorsal aspect of abdomen, male, *M. pronuba* Distant; s—strigil.
FIG. 11. Middle leg, male, *T. selecta* (White).
FIG. 12. Dorsal aspect of abdomen, male, *T. selecta* (White).

PLATE XXXVIII

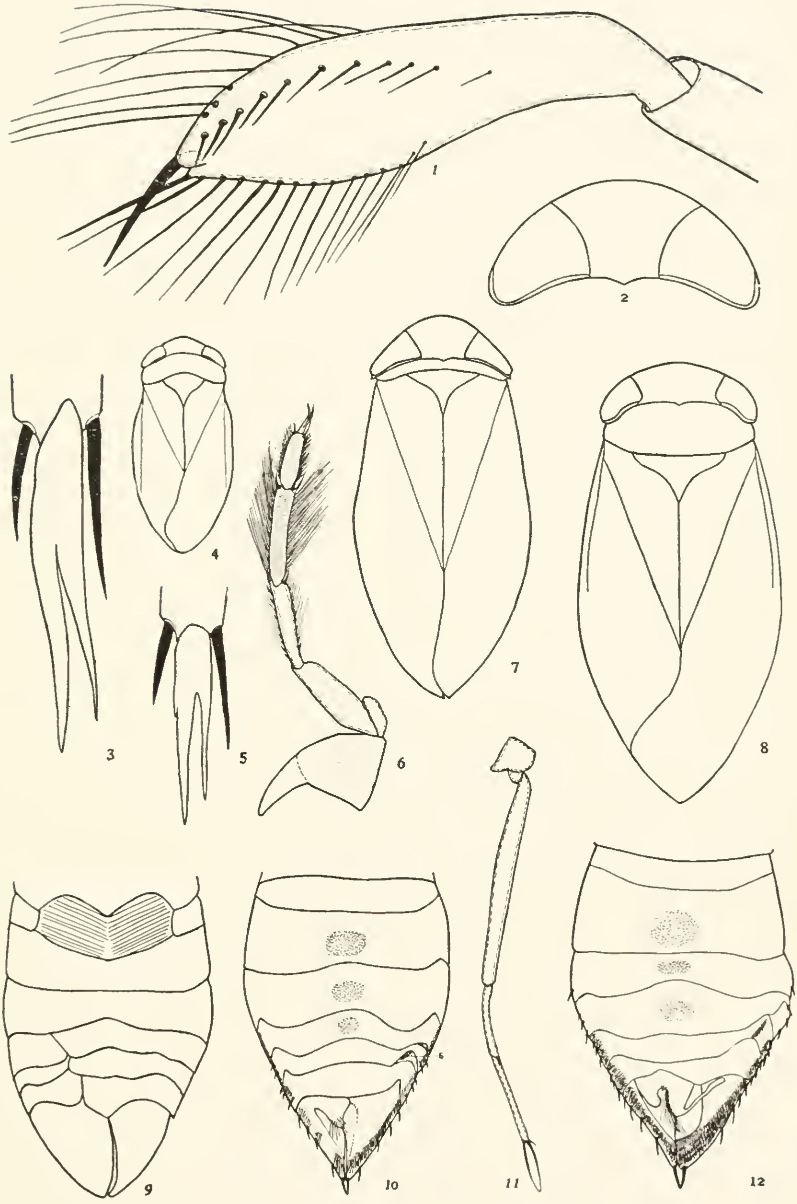
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PLATE XXXIX

FIG. 1. Head and pronotum, *T. truncata* Deay.

FIG. 2. Left part 8th abdominal segment, male, *T. costaricana* Jaczewski.

FIG. 3. Head, *T. hungerfordi* Deay.

FIG. 4. Head, pronotum, scutellum, *T. constricta* Deay.

FIG. 5. Left part 8th abdominal segment, male, *T. pulchra* Hungerford. (Drawn to a larger scale than same structure in other species.)

FIG. 6. Left part 8th abdominal segment, male, *T. constricta* Deay.

FIG. 7. Left part 8th abdominal segment, male, *T. socialis* (White).

FIG. 8. Genital capsule and penis, *T. constricta* Deay.

FIG. 9. Antenna, *T. selecta* (White).

FIG. 10. Left part 8th abdominal segment, male, *T. romani* Lundblad. (Redrawn after Lundblad.)

FIG. 11. Left part 8th abdominal segment, *T. fuscata* (Stal).

FIG. 12. Left part 8th abdominal segment, *T. hungerfordi* Deay.

FIG. 13. Front aspect, prothorax, *T. hungerfordi* Deay.

FIG. 14. Left part 8th abdominal segment, *T. schadei* Lundblad. (Redrawn after Lundblad.)

FIG. 15. Left part 8th abdominal segment, *T. truncata* Deay.

FIG. 16. Left part 8th abdominal segment, *T. melini* Lundblad. (Redrawn after Lundblad.)

FIG. 17. Front aspect, prothorax, *T. selecta* (White).

FIG. 18. Right mandible, male, *T. selecta* (White).

FIG. 19. Right maxilla, male, *T. selecta* (White).

FIG. 20. Left maxilla, male, *T. selecta* (White).

FIG. 21. Left mandible, male, *T. selecta* (White).

FIG. 22. Head and foreleg, male, *T. selecta* (White).

PLATE XXXIX

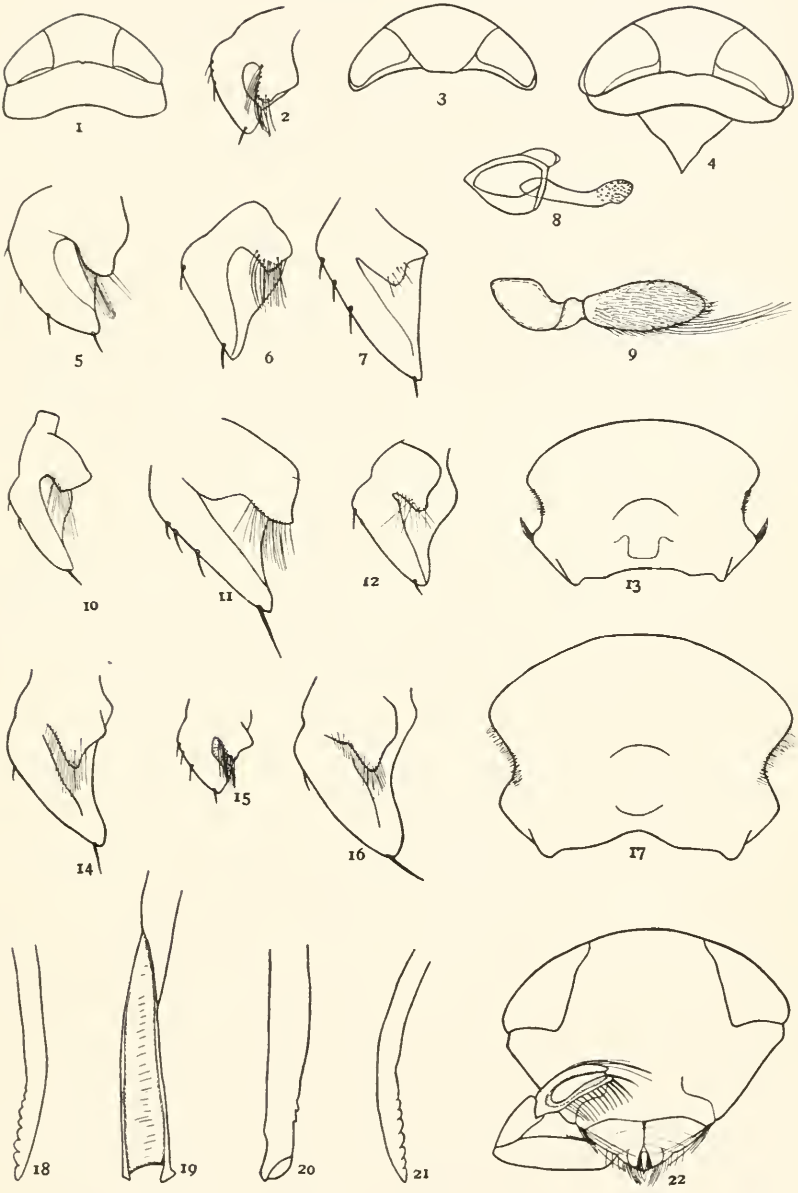
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PLATE XL

FIG. 1. Right clasper, *T. schadei* Lundblad. (Redrawn after Lundblad.)

FIG. 2. Left clasper, *T. hungerfordi* Deay.

FIG. 3. Left clasper, *T. schadei* Lundblad. (Redrawn after Lundblad.)

FIGS. 4 and 5. Left and right claspers, *T. romani* Lundblad. (Redrawn after Lundblad.)

FIGS. 6 and 7. Left and right claspers, *T. constricta* Deay.

FIGS. 8 and 9. Left and right claspers, *T. fuscata* (Stal).

FIG. 10. Right clasper, *T. hungerfordi* Deay.

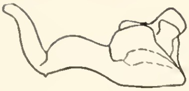
FIG. 11. Left clasper, *T. selecta* (White).

FIGS. 12 and 13. Right and left claspers, *T. melini* Lundblad. (Redrawn after Lundblad.)

FIG. 14. Right clasper, *T. selecta* (White).

Figures 2, 6, 7, 8, 9, 10, 11, 14 drawn to the same scale from microscopic mounts which were studied under a magnification of 450 ×.

PLATE XL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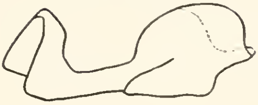
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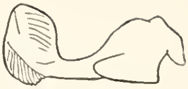
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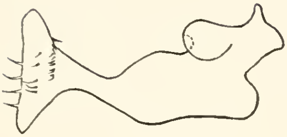
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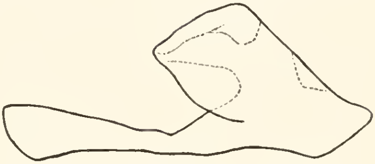
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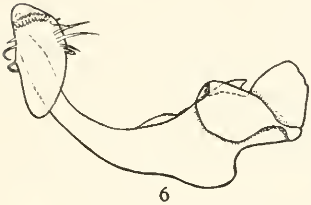
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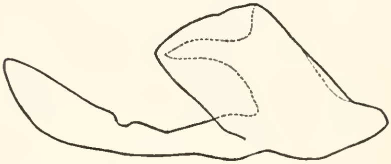
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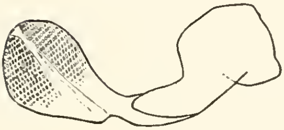
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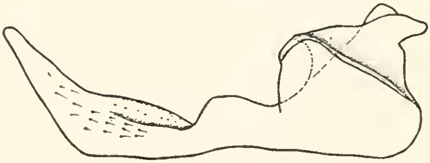
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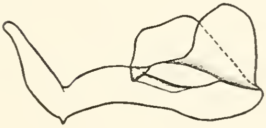
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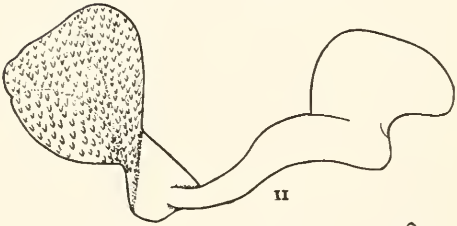
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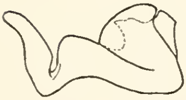
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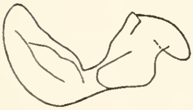
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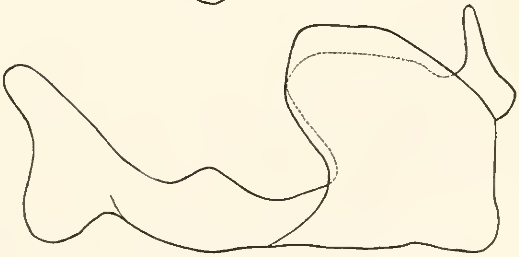
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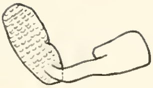
PLATE XLI

FIG. 1. Left clasper, *T. costaricana* Jaczewski.
FIG. 2. Left clasper, *T. pulchra* Hungerford.
FIG. 3. Left clasper, *T. truncata* Deay.
FIG. 4. Right clasper, *T. costaricana* Jaczewski.
FIG. 5. Right clasper, *T. pulchra* Hungerford.
FIG. 6. Left clasper, *T. mexicana* Deay.
FIG. 7. Left clasper, *T. serrata* Deay.
FIG. 8. Left clasper, *T. signata* (White).
FIG. 9. Left clasper, *T. socialis* (White).
FIG. 10. Left clasper, *T. incerta* Lundblad.
FIG. 11. Right clasper, *T. incerta* Lundblad.
FIG. 12. Right clasper, *T. signata* (White).
FIG. 13. Right clasper, *T. mexicana* Deay.
FIG. 14. Right clasper, *T. socialis* (White).
FIG. 15. Right clasper, *T. serrata* Deay.

All figures are drawn to the same scale from microscopic mounts which were studied under a magnification of 450 ×.

PLATE XLI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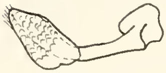
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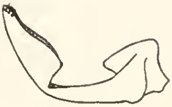
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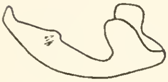
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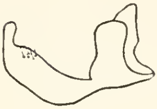
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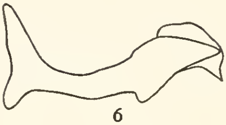
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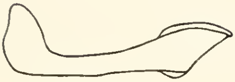
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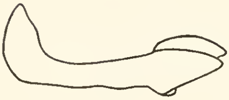
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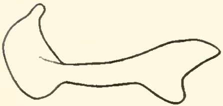
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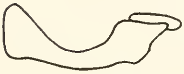
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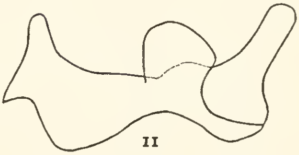
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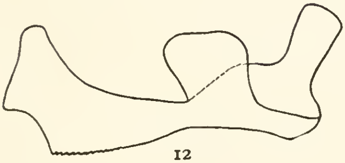
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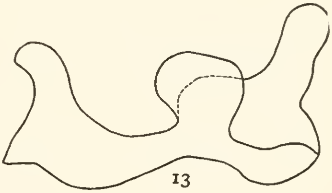
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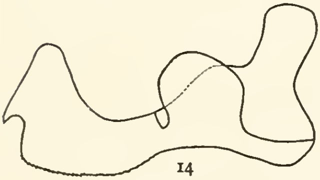
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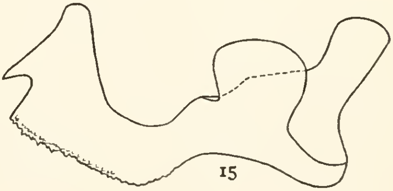
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PLATE XLII

Inner Aspect of Forelegs of Males

FIG. 1. *T. truncata* Deay.
FIG. 2. *T. socialis* (White).
FIG. 3. *T. mexicana* Deay.
FIG. 4. *T. melini* Lundblad. (Redrawn after Lundblad.)
FIG. 5. *T. fuscata* Stal.
FIG. 6. *T. romani* Lundblad. (Redrawn after Lundblad.)
FIG. 7. *T. hungerfordi* Deay.
FIG. 8. *T. constricta* Deay.
FIG. 9. Fore tarsal claw, *T. constricta* Deay.
FIG. 10. *T. selecta* (White).
FIG. 11. *T. costaricana* Jaczewski.
FIG. 12. *T. pulchra* Hungerford.

All figures, except 4 and 6, drawn to the same scale from microscopic mounts which were studied under a magnification of 450 ×.

PLATE XLII

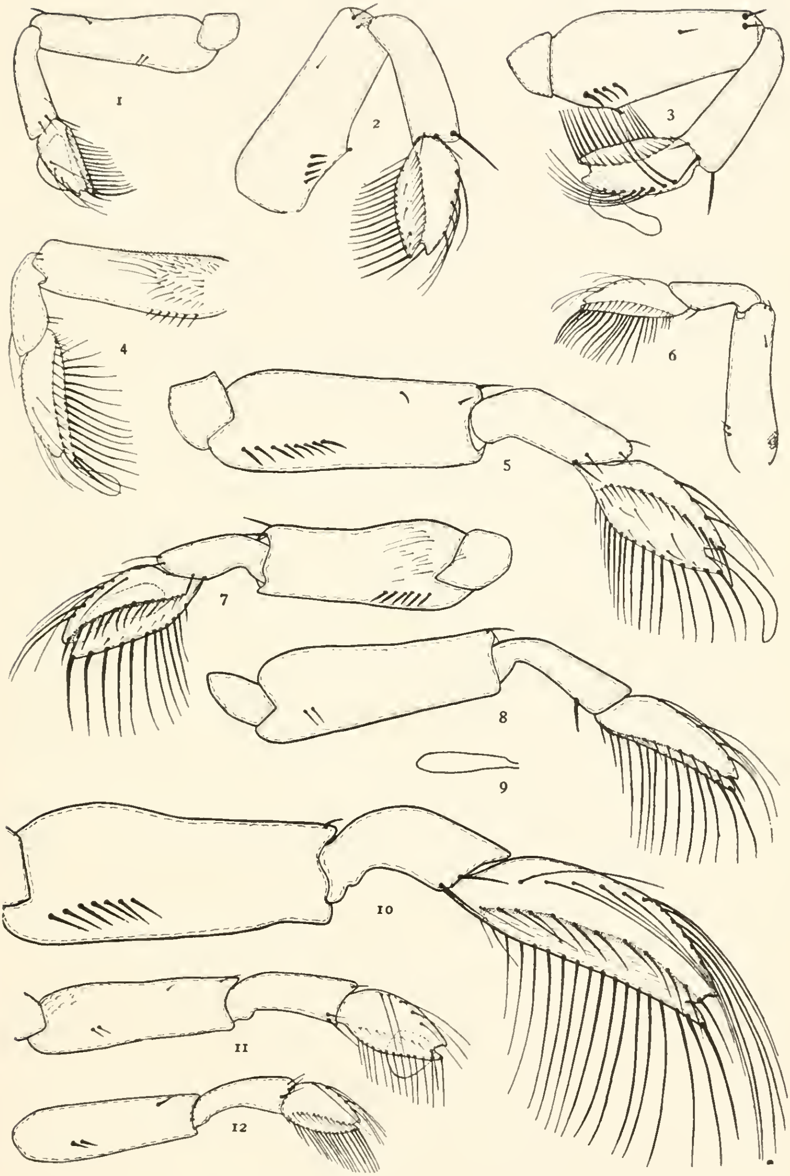
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PLATE XLIII

(See page 471)

Map showing localities in which specimens of Tenagobia have been collected.

FIG. 1. California—*T. mexicana* (?). Reported by Uhler (26).

FIG. 2. Nainari, Sonora—*T. mexicana* Deay. Type locality.

FIG. 3. Mazatlan, Sinaloa—*T. mexicana*.

FIG. 4. Acaponeta, Nayarit—*T. mexicana*.

FIG. 5. Hac de Ixtapa, Tepic—*T. mexicana*.

FIG. 6. El Mante, Tamaulipas—*T. mexicana*.

FIG. 7. Tlapahuala, Guerrero—*T. mexicana*.

FIG. 8. Cuernavaca, Morelos—*T. mexicana*.

FIG. 9. Cardel, Rio San Francisco, Vera Cruz—*T. mexicana*.

FIG. 10. Santa Lucrecia, Vera Cruz—*T. mexicana*.

FIG. 11. Teapa, Tabasco—*T. mexicana*.

FIG. 12. Huixtla, Chiapas—*T. mexicana*.

FIG. 13. Paso Antonio, Guatemala—*T. mexicana*.

FIG. 13a. Near Tela, Honduras—*T. costaricana* Jaczewski.

FIG. 14. Farm Hamburg, Reventazon, Costa Rica—*T. costaricana*. Type locality.

FIG. 15. David, Panama—*T. mexicana*.

FIG. 16. Boqueron River, Panama—*T. costaricana*.

FIG. 17. Venezuela—*T. marmorata* Bergroth. Type locality.

PLATE XLIII—CONTINUED

FIG. 18. Grenada, Lesser Antilles—*T. incerta* Lundblad.

FIG. 19. Trinidad—*T. incerta.*

FIG. 20. Tumatumari, British Guiana—*T. socialis* (White).

FIG. 21. Georgetown, British Guiana—*T. socialis.*

FIG. 22. Demerara River, British Guiana—*T. socialis.*

FIG. 23. Paramaribo, Dutch Guiana—*T. socialis.*

FIG. 24. Cottica, Dutch Guiana—*T. socialis.*

FIG. 25. Tena, Ecuador—*T. truncata* Deay and *T. constricta* Deay. Type locality.

FIG. 26. Tonantins, Brazil—*T. signata* (White).

FIG. 27. Rio Jurua—*T. signata.*

FIG. 28. Rio Purus—*T. signata.* Type locality.

FIG. 29. Manacapura, Amazonas—*T. selecta* (White) and *T. incerta.*

FIG. 30. Manaos, Amazonas—*T. melini* Lundblad (type locality), *T. romani* Lundblad (type locality), *T. selecta* (type locality), *T. socialis.*

FIG. 31. Rio Autaz, left tributary of Maderia—*T. selecta.* Reported by Lundblad (17).

FIG. 32. Trombetas River—*T. socialis.* Type locality.

FIG. 33. Santarem, Para—*T. socialis.*

FIG. 34. Para, Para—*T. incerta.*

FIG. 35. Puerto Bermudez, Rio Pichis, Peru—*T. incerta.*

FIG. 36. Sao Antonio da Boa Vista, Maderia River—*T. socialis.* Type locality.

PLATE XLIII—CONCLUDED

FIG. 37. Pernambuco (Recife), Pernambuco—*T. incerta* and *T. schadei* Lundblad. Reported by Jaczewski (13).

FIG. 38. Ivon Beni, Bolivia—*T. selecta.*

FIG. 39. Rio Beni at mouth of Rio Mapiri—*T. pulchra* Hungerford (type locality) and *T. incerta.*

FIG. 40. Lower Mamore River—*T. serrata* Deay. Type locality.

FIG. 41. Province del Sara, Bolivia—*T. hungerfordi* Deay and *T. incerta.*

FIG. 42. Santa Cruz de la Sierra, Bolivia—*T. incerta.*

FIG. 43. Puerto Saurez, Bolivia—*T. incerta.*

FIG. 44. Corumba, Matto Grosso—*T. hungerfordi* (type locality) and *T. incerta.*

FIG. 45. Piropara, Minas Geraes—*T. incerta.*

FIG. 46. Lassance, Minas Geraes—*T. incerta.*

FIG. 47. Paraguay—*T. fuscata* (Stal) at Albovena Srojoguasi and Villa Rica; *T. hungerfordi* at Villa Rica; *T. incerta* at Asuncion, Caraveni, Molinasque and Villa Rica (type locality); *T. schadei* at Villa Rica (type locality); *T. selecta* at Villa Rica.

FIG. 48. Buenos Aires, Argentina—*T. fuscata.*

FIG. 49. Montevideo, Uruguay—*T. fuscata.* Type locality.

PLATE XLIII

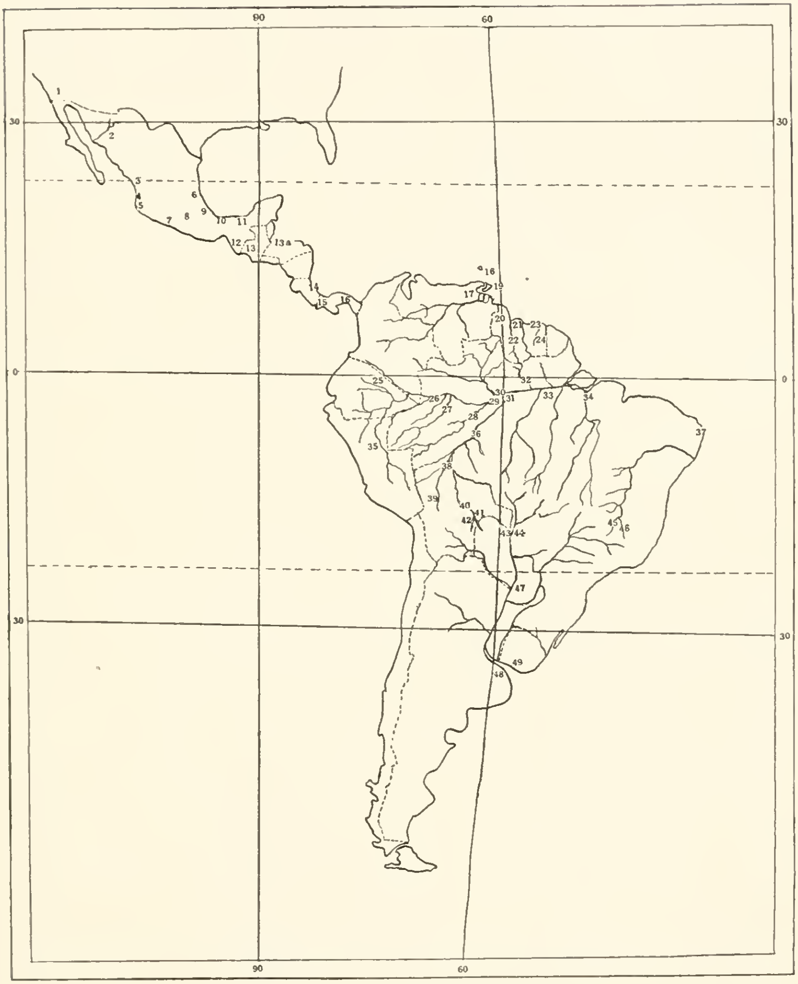
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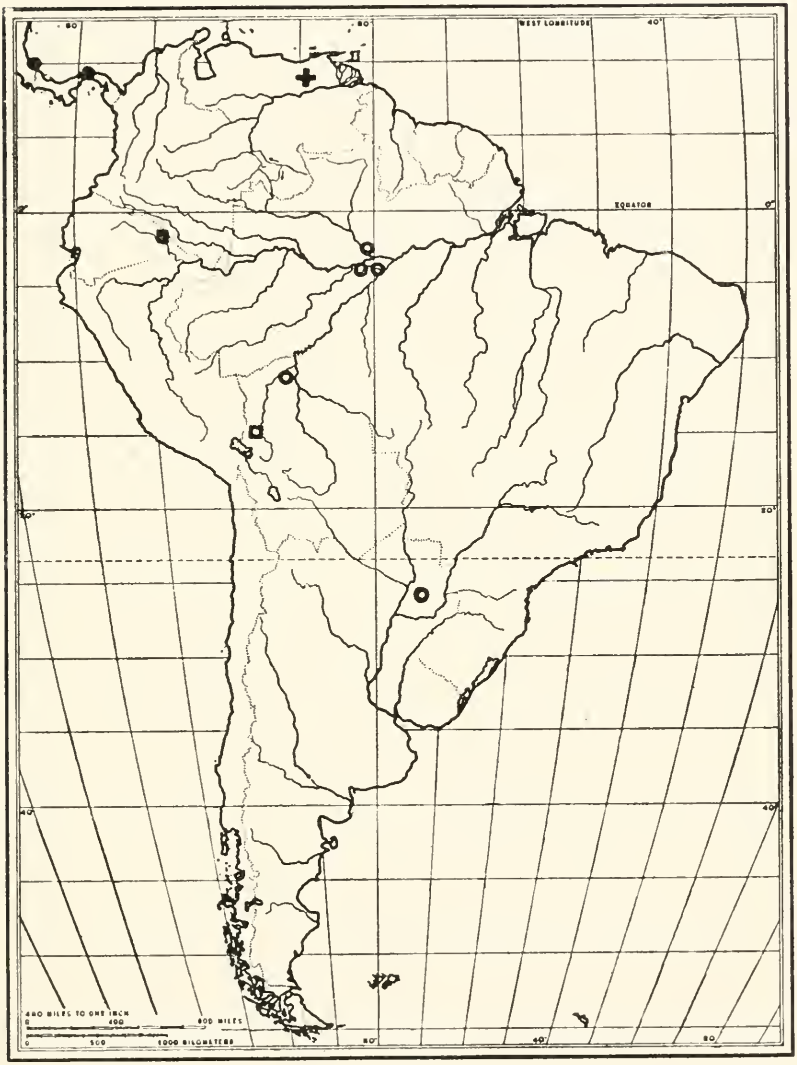
PLATE XLIV

Map showing localities in which the *Truncata* group and *T. selecta* have been collected.

● *T. costaricana* Jaczewski. (Also taken in Honduras.)
✤ *T. marmorata* Bergroth.
□ *T. pulchra* Hungerford.
○ *T. selecta* (White).
■ *T truncata* Deay.

PLATE XLIV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EQUATOR
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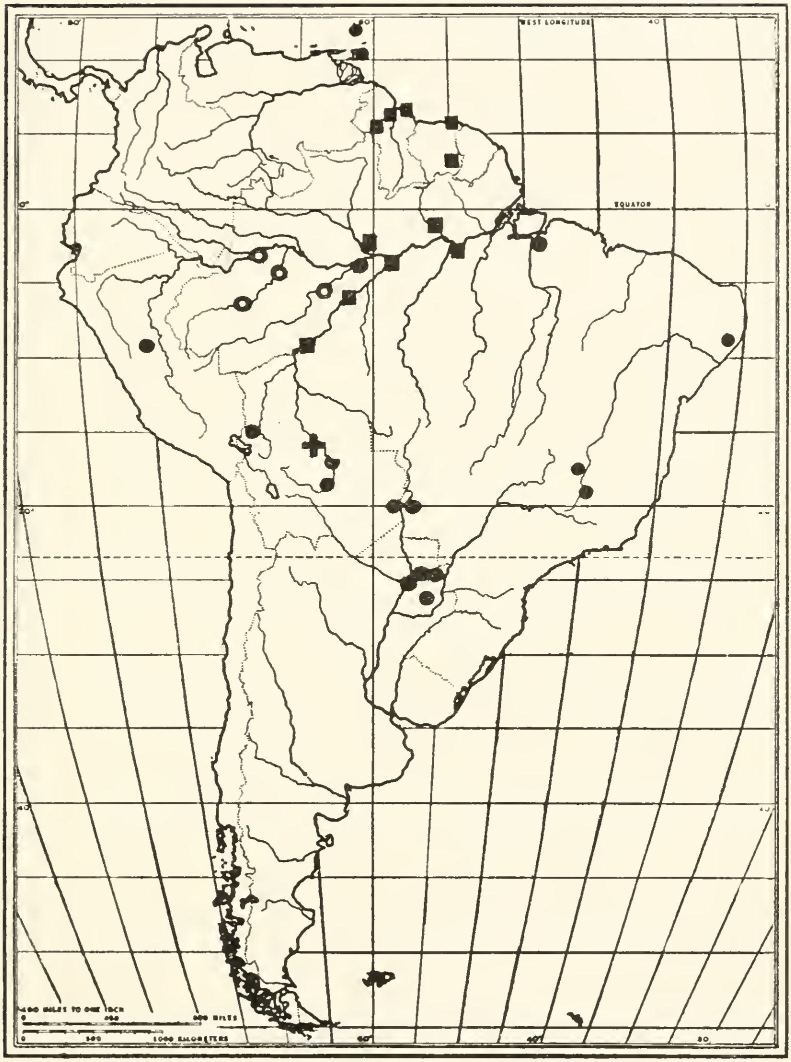
60
40°
20
0°
20°
40°
40
480 MILES TO ONE INCH
0
400
800 MILES
0
500
1000 KILOMETERS

PLATE XLV

Map showing localities in which the South American members of the *Signata* group have been collected. See Plate XLIII for distribution of *T. mexicana*.

● *T. incerta* Lundblad.
✤ *T. serrata* Deay.
○ *T. signata* (White).
■ *T. socialis* (White).

PLATE XLV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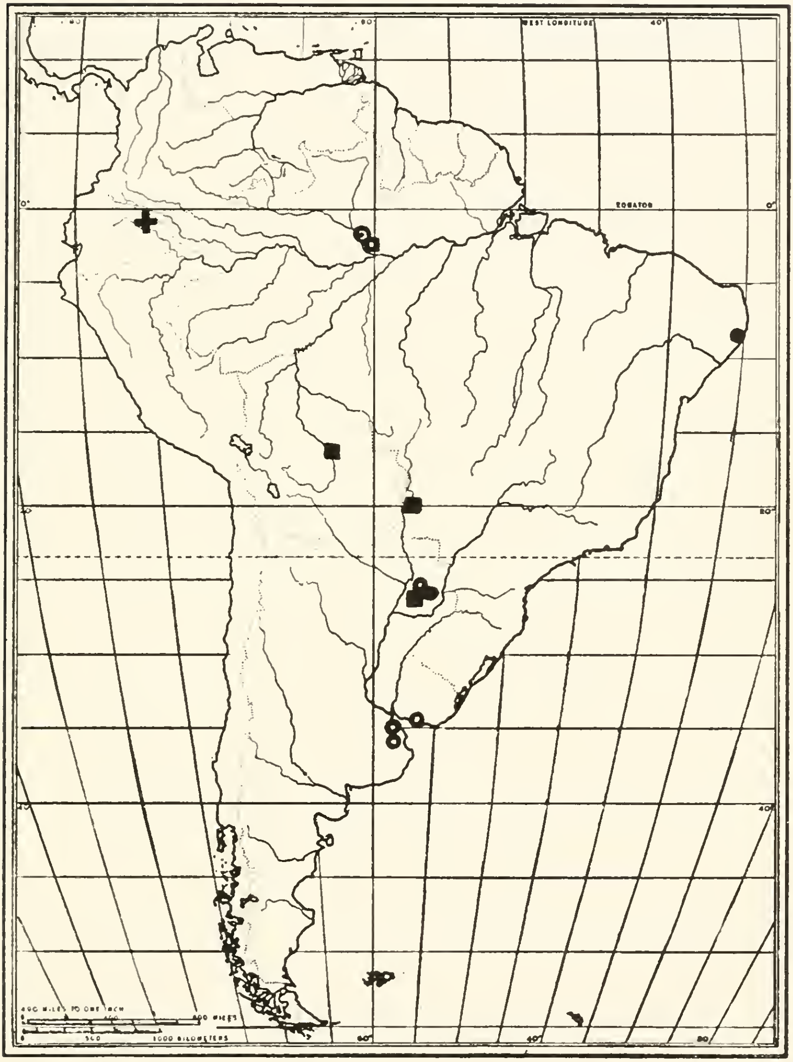
800 MILES
1000 KILOMETERS

PLATE XLVI

Map showing the localities in which the species composing Group I have been collected.

✤ *T. constricta* Deay.
○ *T. fuscata* (Stal).
■ *T. hungerfordi* Deay.
⊙ *T. melini* Lundblad.
□ *T. romani* Lundblad.
● *T. schadei* Lundblad.

PLATE XLVI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500
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20°

or individual masses.* Since this collection represented a larger number of Lethocerus eggs than Doctor Hungerford had seen in ten years collecting in this region, he suggested that with this abundant material I endeavor to rear the species. In the pool we caught one adult *Lethocerus americanus* (Leidy) and nymphs of various sizes up to the fourth instar.

The next few days were spent in visiting the ponds in the region of the Douglas Lake Station in search for other egg masses. The results, which are shown in the chart below, were most gratifying, for I collected a total of nine clusters, all but two compound, representing thirty masses, and a total of 2,118 eggs.

The pool where most of the eggs were found is known as the Sedge Point pool and is located directly north across Douglas Lake from the Station buildings. It is well known to all who have ever attended the Biological Station because of the excellent collecting that it affords both zoölogist and botanist. The pool is about 100 feet or more from the shore of Douglas Lake. It is approximately 50 feet wide and 150 feet long. It has a luxuriant flora common to a lenitic society. The principal plants are Typha, eel grass and water lilies. While all but one† of my collections were found on dead Typha stems from five inches to a foot or more above the water, Doctor Hungerford has collected them on logs and under boards on the shore.

CHART OF EGGS COLLECTED

Date collected.	Place.	Number of masses.	Number of eggs.
June 27	Gravel pit pool	5	375
June 27	Gravel pit pool	8	569
June 28	Sedge point pool	3	145
June 27	Gravel pit pool	1	73
June 27	Gravel pit pool	2	154
June 28	Sedge point pool	1	85
June 24	Sand pit pool	2	145
June 28	Sedge point pool	4	302

TYPES OF AQUARIA AND CONTAINERS

The egg clusters brought into the laboratory were supported on cattail stems above water in large, glass battery jars twelve inches in diameter and eighteen inches deep. As the eggs hatched the nymphs fell to the water. It was soon observed that the older nymphs would attack and kill the recently hatched nymphs, especially when no other food was given them. This made it necessary for the nymphs to be isolated in individual aquaria. A large number of glass finger bowls were used for this purpose. They were about four inches across and two inches deep. Two or three pebbles were placed in each, and a couple of pieces of dead cattail stem were floated on the water, to give the bugs something for support.

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* See Plate XLVIII, figure 3.

† This one was attached to a reed.

In addition to the laboratory rearings, it was decided to take some of the one-day-old nymphs over to Sedge pool and place them in cages, where they would have more natural conditions and yet could be observed and fed daily. Some ordinary window screen cylinders, six inches in diameter and a foot in height were used. The bottoms were of screen and the tops were cheese-cloth tied on with string. Two dozen of the cages were placed in Sedge pool. They were placed in about six inches of water between two logs that were staked down. Later a larger cage was made. This cage, shown in figure 4, Plate XLVIII, was two feet square and a foot deep. Tin was cut and soldered to form sixteen compartments. It was easier to care for and observe the bugs in this cage because the trouble of removing and replacing the cheesecloth, as on the cylinder cages, was avoided.

As the nymphs in the laboratory reached the fourth and fifth instars, they were placed in gallon glass jars, which gave them more room.

On August 15 when the summer session at the Michigan Biological Station closed, twenty of the fifth instar nymphs were placed singly in one-half pint ice-cream containers with some dampened grass and leaves and transported by automobile to the University of Kansas laboratory at Lawrence, Kansas. The nymphs withstood the two-days journey with only one fatality.

FOOD

One of the most interesting parts of the study was in observing the way in which the bugs fed. While collecting with a dip net several of the nymphs were captured as they were feeding on tadpoles. These young amphibians proved to be the most satisfactory food and were used as such in rearing the bugs. Each day a field trip was made to collect tadpoles with a minnow seine. The nymphs were fed every second day. A tadpole would be dropped into the aquarium and, although quite often the tadpole would weigh many times that of the bug, the bug would strike, grasp its prey with its forelegs and at the same time plunge its beak into the body. It was very unusual for the nymph to be shaken loose, although there was always a great deal of thrashing around in the jar by the

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Life History of *Lethocerus Americanus* (Leidy)* (Hemiptera-Belostomatidae)

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ABSTRACT: The common and widespread American giant water bug *Lethocerus americanus* (Leidy) places its egg clusters on reeds above the surface of the water. There are five nymphal instars. From egg to adult, using tadpoles as food, 33.4 days was average developmental period for field-reared specimens and 58.9 days for laboratory-reared specimens. Tadpoles and small frogs proved to be the best food. Of the seven pairs of abdominal spiracles functional in the nymph only the last pair is functional in the adult. These are located near the base of the retractile caudal filaments.

INTRODUCTION

THE genus LETHOCERUS Mayr, 1852, contains, according to Cummings,[17] 18 species, of which 13 occur in the Western Hemisphere. These bugs are often called "Giant Water Bugs" or "Electric Light Bugs"; and the most common American species is *Lethocerus americanus* (Leidy) 1847.

Although several papers on the anatomy of this and closely related insects have been published by such men as Locy, 1884,[1] Martin, 1893,[6] and C. V. Riley, 1894,[7] little has appeared on the biology. Such papers as have been published are not complete. Dimmock, 1886,[5] mentioned the fact that species of Belostoma (referring no doubt to Benacus and Lethocerus) were destroying young fish in the state fish hatcheries of Massachusetts. Hungerford, 1919,[13] gives notes on the habits, hibernation, oviposition, feeding habits, etc., but ends his paper with the summary: "These giant water bugs, distinguishable by the presence of a groove in the fore femora, are fiercely predaceous creatures of our larger ponds. In their nocturnal migrations from one body of water to another they are frequently attracted to the lights.

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* Contribution from the University of Michigan Biological Station and the Department of Entomology, University of Kansas.

"The eggs of *L. americanus* (Leidy) and *L. uhleri* (Mont.) are now known. In nature they are laid on reeds above the surface of the water. Nothing is known about the length of the various stages." Bueno, 1924,[15] describes the last molt of *L. americanus*. Hoffman, 1924,[14] published some biological observations on the overwintering of the adults, feeding habits, and described the molting process. Hungerford in another paper in 1925[16] described the eggs and the hatching process of *L. americanus*. These papers all show the interest that these large water bugs have attracted, and it is strange that the life history has not been more fully studied. In the following pages are presented the data collected during the past season on *Lethocerus americanus* (Leidy).

I wish to express my appreciation to Dr. H. B. Hungerford, head of the Department of Entomology of the University of Kansas, for the opportunity of making this study, as well as for his kindly help and criticism. I also wish to acknowledge my indebtedness to Dr. George R. La Rue, Director of the University of Michigan Biological Station, for the facilities that he placed at my disposal.

HABITAT AND DESCRIPTION OF EGG MASSES

On the morning of June 27, Dr. H. B. Hungerford and I made a collecting trip to a gravel pit pool near Pellston, Mich. This pool had been known to Doctor Hungerford for a number of years and is an ideal pool for aquatic and semiaquatic insects. The gravel pit pool, as indicated by its name, is the result of the removal of gravel some years before; the bottom is clay and gravel but a layer of sediment of some three or four inches covers the harder bottom. The pool is divided by certain grass-covered islands. Along the margin a good stand of cattail (Typha) has taken root. It was on the dead stems of this Typha that four egg masses of *L. americanus* were found; one an unusually large mass or cluster consisted of 8 layers captured tadpole. A few times the tadpole jumped completely out of the bowl onto the table with the bug still clinging on. It was discovered that in some cases the mouth parts of the insect were seriously injured so that death resulted from the struggle. Thereafter, the tadpoles were intentionally injured before they were used for food. Uninjured tadpoles, however, were quickly subdued, which would indicate that the bugs must secrete some poison that apparently paralyzes the prey. Damsel-fly naiads were used as food for the first instar nymphs. Small fish and beefsteak were also tried but proved much less satisfactory than tadpoles.

It was necessary to remove the food soon after the insect completed feeding and to change the water in the rearing bowl. The insects died if left long in water contaminated by the decomposing tadpoles. In warm weather two or three hours would bring about a condition of the water unsuitable for the insect. The care of several hundred isolated nymphs in the laboratory was therefore time-consuming. The nymphs in the cages in Sedge pool were also fed tadpoles. Toward the end of the season young frogs were much easier to collect than were tadpoles, so they were used as food for the bugs. In this case the small frogs were cut in two and only one half given to each nymph. In order to get a bug to feed it was necessary to move the frog about in the bowl to attract its attention.

DESCRIPTION OF STAGES

EGG STAGE

Size. Length, 5 mm.; greatest width, 2.5 mm.

Color. Light brown, the apex or anterior end being a cap or lid, which is much darker and is set off by a light circle between the lid and the body of the egg. At one side on the margin of the lid is a very dark spot—this is the side that lifts up at the time of hatching. A microscope shows that the brown shading of the corium is caused by a fine stippling, there being no indication of other ornamentation as often occurs in the Hemiptera.

Shape. Irregularly shaped cylinder, the anterior end rounded, the posterior more pointed, the greatest diameter being nearer the anterior than the posterior end. The shape is best shown in the photograph on Plate XLVIII. During incubation it was observed that the egg increases in size; this varying in the same egg mass.

I observed the emergence of several of the nymphs. One evening one of the egg masses was placed under the binocular, and a few minutes later several of the caps on the eggs popped open. At first the head was gradually pushed through the opening and then with rather weak heaves the rest of the body was drawn out, with the exception of the legs, which were still held pressed to the body and were still in the opening of the shell. Finally, with a last effort, the little bug broke through the membrane that had still surrounded him, and with the help of his legs, pulled on out and fell to the water below (normally 5 or 6 inches), where he lay quietly on the surface for a moment and then feebly swam away. This hatching process takes between six and eight minutes.

FIRST INSTAR

Size. Length, 10 mm.; greatest width, 5 mm.

Color. Dorsum: brown; thorax with few indistinct light yellow markings. The abdomen with six yellow spots on the connexival edges; these spots are large and rectangular. There are six other yellow spots along the median line. Venter: brown, few yellow markings. The legs banded with yellow; each femur and tibia having two bands. These markings give the nymph a general banded appearance.

Shape. Much as in the adult. The interocular space is relatively greater.

Structural Characteristics. Ventral part of the abdomen clothed with fine hairs. Tarsi all one-segmented and each has two claws. There are seven pairs of abdominal spiracles and two pairs of thoracic spiracles.

SECOND INSTAR

Size. Length, 15 mm.; greatest width, 8 mm.

Color. Same markings as first instar only lighter in color. Barred effect not as evident as on first instar.

Shape. Comparatively broader than in the first instar. The antennae are shown in Plate XLVII. Claws of each tarsus of equal length.

THIRD INSTAR

Size. Length, 22 mm.; greatest width, 11 mm.

Color. Same as the second instar, the same markings still evident. The venter is of a slightly lighter shade, a whitish-grey.

Structural Characteristics. The wing pads may be seen in Plate XLVII as well as the developing antennae.

FOURTH INSTAR

Size. Length, 31 mm.; greatest width, 14.5 mm.

Color. Same general brown as in the preceding instars.

Shape. Same shape as others except the length is a little greater in comparison to the width. Wing pads are about four fifths of the total marginal length of the meso and metathorax. Antennae are beginning to develop two lateral processes. (See Plate XLVII.)

FIFTH INSTAR

Size. Length: Male, 39 mm.; female, 43 mm. Width: male, 18 mm.; female, 21 mm.

Color. Generally brown, but darker on the dorsum and lighter on the venter.

Shape. Practically the same. Length, in comparison to width, is still greater than in the fourth instar.

Structural Characteristics. Antennae much broader in comparison to length. Wing pads extend short distance beyond the metathorax. (See Plate XLVII.) Tarsi still one-segmented, each having two claws of equal length. (The tarsi of the forelegs in the adult having two segments and only one claw.) The straplike, caudal appendages are becoming fairly well developed, but the nine pairs of spiracles are still functional, although the last or seventh abdominal is the only abdominal one functional in the adult. This spiracle in the adult is in the retractile caudal filament, and is directly connected with the principal, longitudinal trachea.

The measurements mentioned above were taken from live specimens and also checked with the molted skins. The molted skins of all specimens were carefully preserved.

Length in Days of Nymphal Stages of *Lethocerus americanus* (Leidy) reared at Douglas Lake, Michigan.

	First instar.			Second instar.			Third instar.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
Reared in laboratory.........	18	6	9.2	12	2	8.2	14	5	8.5
Reared in Sedge pool.........	7	2	5.0	8	3	4.9	23	4	5.7

	Fourth instar.			Fifth instar.			Totals.		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
Reared in laboratory.........	17	9	11.5	28	15	21.5	89	38	**58.9**
Reared in Sedge pool.........	9	4	6.	15	10	11.8	62	23	**33.4**

As will be seen in the table above, the average developmental period was 33.4 days for the bugs reared in Sedge pool and 58.9 days for those reared in the laboratory. Not only was there marked difference in time required for development between the field and laboratory rearings, but the number of adults secured was much larger in the field. In the laboratory 45 percent of the nymphs died in the second instar, and 18 percent in the third instar, a total of 63 percent perishing before attaining the fourth instar, whereas in the field cages not a single death occurred before the fourth instar.

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PLATE XLVII

Fig. 1. First instar, *L. americanus.*
Fig. 2. Second instar.
Fig. 3. Third instar.
Fig. 4. Fourth instar.
Fig. 5. Fifth instar.
Fig. 6. First instar antenna.
Fig. 7. Second instar antenna.
Fig. 8. Third instar antenna.
Fig. 9. Fourth instar antenna.
Fig. 10. Fifth instar antenna.

PLATE XLVII

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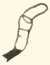
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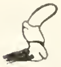
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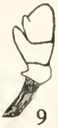
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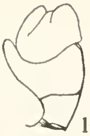
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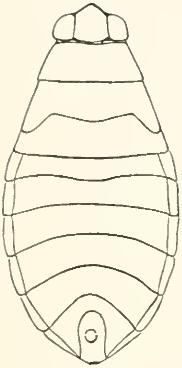
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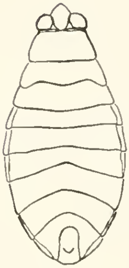
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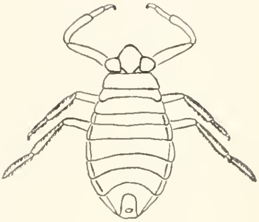
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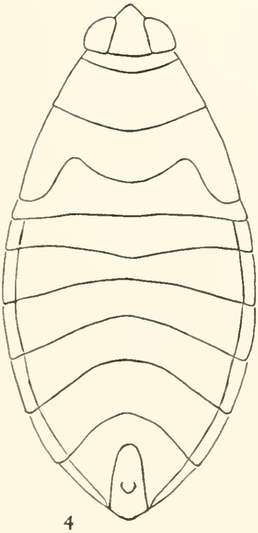
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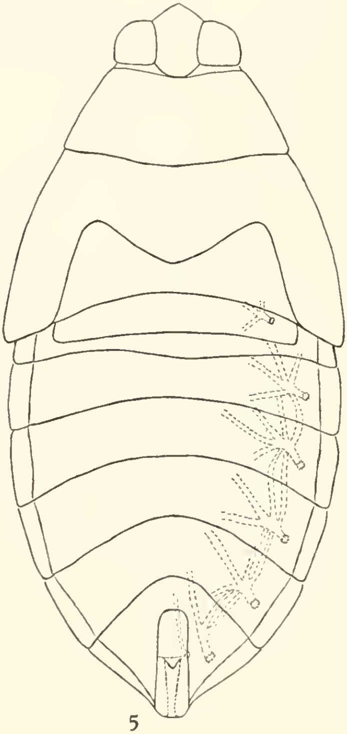
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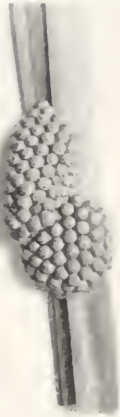
PLATE XLVIII

FIG. 1. Egg mass "E."
FIG. 2. Egg mass "C."
FIG. 3. Egg mass "B."
FIG. 4. Cages in Sedge pool.
FIG. 5. Egg mass "A" on a stem of Typha as found.
FIG. 6. Adult *L. americanus*.

PLATE XLVIII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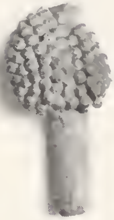
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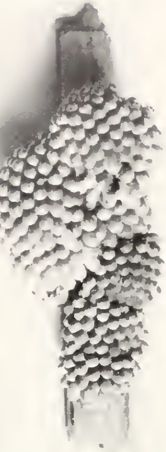
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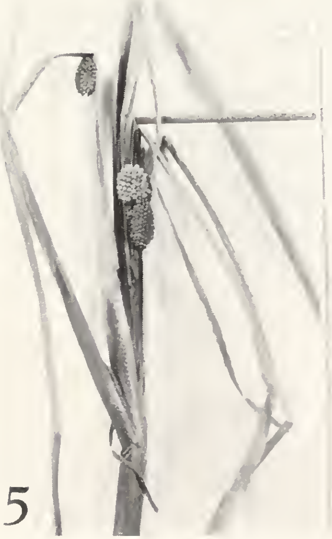
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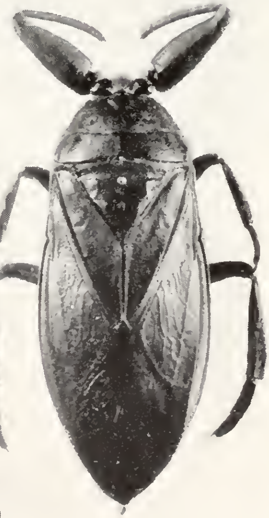
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SCIENCE BULLETIN

VOL. XXII.] APRIL 15, 1935 [NO. 16.

The Genus Abedus Stal. (Hemiptera, Belostomatidae)

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ABSTRACT: The genus ABEDUS is found only in the New World, where it is confined to the territory extending from California and Arizona through Mexico to Panama. *Abedus herberti* from Arizona is described as new. (Types in the Francis Huntington Snow Collection of the University of Kansas.)

The following species are keyed out and redescribed: *A. signoreti* Mayr, *A. ovatus* Stal, *A. breviceps* Stal, *A. dilatatus* (Say), *A. macronyx* (Mayr), *A. montandoni* De Carlo, *A. hungerfordi* De Carlo and *A. indentatus* (Hald).

THE Belostomatidae is a family of aquatic Hemiptera, most species of which are above average size. While these insects rear their young and spend most of their adult lives in the water, they frequently fly by night and are attracted to lights. Thus they come to the attention of many people. The larger forms especially are known as giant water bugs or electric light bugs. The family is widely distributed over the world and is divided into a number of genera. One of these genera is Abedus Stal, which is confined to a restricted portion of the new world.

Abedus Stal was erected by Stal in 1862 to embrace two new species of Belostomatidae which he named *Abedus ovatus* Stal, and *Abedus breviceps* Stal. He characterized the genus as follows: metasternum strongly keeled; antennae four segmented with a long curved prolongation from the second and third segments; abdominal venter lacking strong hairs, at least in the middle.

In 1862, in the same paper, Stal established the new genus Serphus, differentiating it from Abedus Stal in that it has an entirely pubescent abdominal venter and three-segmented antennae, and placed the species *Belostoma dilatatus* Say in this genus.

In 1863 Mayr established the genus Stenoscytus Mayr, using as characteristics: the first joint of the beak longer than the second;

only the third joint of the antennae with a prolongation; and metasternum with a long and stout metaxyphus. *Stenoscytus mexicanus* Mayr was described under the genus. In the same paper Mayr, 1863, created the genus Pedinocoris, separating it from Stenoscytus Mayr by the following characters: first joint of the beak shorter than the second; a prolongation from the second and third segments of the antennae; and metaxyphus not keeled. He described the species *Pedinocoris macronyx* Mayr and *P. brachonyx* Mayr. In 1871, Mayr placed the genus Stenoscytus Mayr in synonymy with *Abedus* Stal.

In 1897 Kirkaldy established the genus *Deinostoma* Kirk. He placed Say's *Belostoma dilatatus*, which had been described in 1831 by Say, and designated by Stal in 1862 under *Serphus dilatatus* (Say), under the new genus Deinostoma Kirkaldy, and characterized the genus Deinostoma Kirk. as having a metasternal keel, a three-segmented antenna, and an entirely pubescent abdominal venter.

J. A. De Carlo,[4] in his work, considers Serphus Stal, 1862, Stenoscytus Mayr, 1863, Pedinocoris Mayr, 1863, and Deinostoma Kirk., 1897, as synonyms of Abedus Stal.

The key metasternum for the genera of the family Belostomatidae found in North America is as follows:

A. Metasternum with a strong mid-ventral keel (or at least elevated); membrane of the hemelytra reduced .... *Abedus* Stal
AA. Metasternum without a mid-ventral keel; membrane of the hemelytra not reduced.
  B. Basal segment of the beak longer than the second; base of the wing-membrane nearly or quite straight. Body about 25 mm. or less in length .... *Belostoma* Latr.
  BB. Basal segment of the beak shorter than the second; base of the wing-membrane sinuous. Body more than 37 mm. in length.
    C. Anterior femora grooved for the reception of the tibiae. *Lethocerus* Mayr
    CC. Anterior femora not grooved for the reception of the tibiae. *Benacus* Stal

The distribution of the genus *Abedus* Stal extends from California to Panama as shown by the map on page 519, plate LII.

The following nine species are recognized in this paper: *A. signoreti* Mayr; *A. ovatus* Stal; *A. breviceps* Stal; *A. dilatatus* (Say); *A. macronyx* (Mayr); *A. indentatus* (Hald.); *A. montandoni* De Carlo; *A. hungerfordi* De Carlo; and *A. herberti* n. sp.

Mayr described *Stenoscytus mexicanus* Mayr as a new species in 1863. Champion, 1901, figures this species as a synonym of *Abedus ovatus* Stal.

Abedus vicinus was described by Mayr in 1871. A female specimen was the type specimen. Champion, 1901, says that with the types of *A. signoreti* Mayr and *A. vicinus* Mayr before him, he cannot see any specific differences. Mayr used a male specimen in describing *A. signoreti* Mayr, which probably is responsible for the slight differences which caused him to describe the female and male as separate species.

Haldeman[6] described *Abedus indentatus* (Hald.), 1853, under the genus Zaitha. Uhler, 1877, placed this species under the genus Pedinocoris Mayr, and made *Pedinocoris brachonyx* Mayr synonymous with *indentatus*. In 1900 Montandon placed Serphus Stal, Pedinocoris Mayr and Deinostoma Kirkaldy, synonyms of Abedus Stal.

The species are separated into two main groups, one with abdominal venter entirely pubescent and the other in which the abdominal venter is not entirely pubescent. In the first group there are six species, three of which—*A. dilatatus* (Say), *A. macronyx* (Mayr), and *A. montandoni* De Carlo—have three-segmented antennae, with or without a definite prolongation from the second segment and none from the third segment. *A. dilatatus* (Say) can be separated from the other two species by having the metaxyphus keeled. *A. macronyx* (Mayr) is separated from *A. montandoni* De Carlo in that *A. macronyx* has a three-segmented antenna with no prolongations and *A. montandoni* De Carlo has a three-segmented antenna with a short prolongation from the second segment. The other three species in the first group are: *A. hungerfordi* De Carlo; *A. indentatus* (Hald.); and *A. herberti* n. sp. *A. hungerfordi* De Carlo has four-segmented antenna with a prolongation from the second and third segments and the other species have three-segmented antennae with a prolongation from the second and third segments. *A. indentatus* (Hald.) has very short and stout front tarsal claws (three fourths as long, or less than the terminal tarsal segment); while *A. herberti* n. sp. has front tarsal claws as long or longer than the terminal tarsal segment. *A. herberti* n. sp. also differs from *A. indentatus* (Hald.) in that the caudal filaments of *A. herberti* n. sp. have a swollen pouch-like structure on the dorsal side.

In the second group the three species *A. signoreti* Mayr, A. *ovatus* Stal, and *A. breviceps* Stal, may be separated by the abdominal venter characters, the antennae and the caudal filaments. *A. signoreti* Mayr has the abdominal venter entirely glabrous (in some specimens there is a little pubescence along the lateral borders of the pleura), the antennae are three- or four-segmented with a long prolongation from the second and third segments, the membrane of the hemelytra with conspicuous closed cells, and caudal filaments long and slender. *A. ovatus* Stal has the abdominal venter with an elongated, inverted, V-shaped glabrous area along the median ridge, the antennae three- or four-segmented with a very short prolongation from the second and third segments, and the membrane of the hemelytra with no conspicuous closed cells, and *A. breviceps* Stal has the abdominal venter covered with an irregular, fairly broad, glabrous area along the median ridge, antennae three- or four-segmented with a long prolongation from the second and third segments, and the membrane of the hemelytra with conspicuous closed cells.

A general survey of the characters of the genus Abedus Stal was made. The antennae were studied first, but their characters were found not to be specific, although they have proven to be good group characters. The antennae are either three- or four-segmented, with or without prolongations from the second and third segments. When only one of the segments is prolonged, it is the second, but the third segment is never prolonged alone. The greatest variation in antennal characters is found within the species *A. signoreti* Mayr. The antennae are three- or four-segmented, with the second and third segments bearing a prolongation. The prolongations of the second and third segments vary in the degree of curvature from a pronounced curve to a straight segment.

The metaxyphus was found to be a good group character, but not specific. The form and degree of elevation of keel varies to a great extent within the species. The abdominal venter shows good specific characteristics. Its degree of pubescence separates the species into two groups. One group has an entirely pubescent abdominal venter. This group includes *A. dilatatus* (Say), *A. macronyx* (Mayr), *A. montandoni* De Carlo, *A. hungerfordi* De Carlo, *A. indentatus* (Hald.), and *A. herberti* n. sp. In the other group are included *A. signoreti* Mayr, *A. ovatus* Stal, and *A. breviceps* Stal. The species of the latter group can be separated by the degree of pubescence on the abdominal venter.

The length of the fore-tarsal claws is the character used in separating *A. indentatus* (Hald.) from the following similar species: *A. hungerfordi* De Carlo, *A. dilatatus* (Say), *A. macronyx* (Mayr), and *A. herberti* n. sp. *A. indentatus* (Hald.) has the front tarsal claws not more than three fourths as long as the terminal segment, while in the other species the front tarsal claws are as long or longer than the terminal tarsal segment. The tarsal claws of the middle and hind legs show no specific characters.

The wings show differential characteristics only in the membrane. The membrane of the hemelytra of *A. ovatus* Stal is very narrow and lacks closed cells. In the other species the width of the membrane varies with the size of the species.

The size of each species varies within certain measurements, but since several species may be about the same size, it is a character which is not worth considering.

The genitalia do not even show group characters. The caudal filaments are specific in character. The long and slender caudal filaments of *A. signoreti* Mayr separate it from the other species. The caudal filaments of the other species are somewhat similar, but separate the species into two groups. The first group has caudal filaments with a swollen pouch-like structure on the dorsal side about the middle of each filament. It includes *A. ovatus* Stal, *A. herberti* n. sp., and *A. dilatatus* (Say). The second group, *A. breviceps* Stal, *A. hungerfordi* De Carlo, *A. indentatus* (Hald.), and *A. montandoni* De Carlo, have no such structure.

The interocular space as compared with the width of the hind tibiae was also considered, but it was found that the proportions of the measurements vary with the size of the species.

KEY TO THE SPECIES OF THE GENUS *Abedus* STAL.

1. Abdominal venter entirely pubescent.. 4

1A. Abdominal venter not entirely pubescent.. 2

2. Abdominal venter entirely glabrous; (in some specimens some degree of pubescence is present along the pleural border), antennae three- or four-segmented with a long prolongation from the second and third segments..*signoreti* Mayr, p. 498

2A. Abdominal venter not entirely glabrous.. 3

3. Abdominal venter with an elongated, inverted, V-shaped glabrous area along the median ridge; antennae three- or four-segmented with a very short prolongation from the second and third segments; caudal filaments short, broad, and with a swollen pouch-like structure on the dorsal side, about mid-length of each filament ....*ovatus* Stal, p. 499

3A. Abdominal venter with an irregular, fairly broad, glabrous area along the median ridge; antennae three- or four-segmented with a long prolongation from the second and third segments; caudal filaments short and broad...*breviceps* Stal, p. 501

4. Antennae three- or four-segmented with a definite prolongation from the second and third segments.. 7

4A. Antennae three-segmented with or without a definite prolongation from the second segment, none from the third.. 5

5. Metaxyphus keeled; caudal filaments long, broad, with a swollen-like structure on the dorsal side of each filament, and a band of dark hairs across each filament beyond the middle..*dilatatus* (Say), p. 502

5A. Metaxyphus not keeled.. 6

6. Antennae three-segmented with no prolongation from any segment. *macronyx* (Mayr), p. 503

6A. Antennae three-segmented, with a short prolongation from the second segment. *montandoni* De Carlo, p. 504

7. Antennae four-segmented; a prolongation from the second and third segments; caudal filaments long, broad, and stout................*hungerfordi* De Carlo, p. 505

7A. Antennae three-segmented; a prolongation from the second and third segments... 8

8. Front tarsal claws very short and stout (three fourths as long or less, than the terminal tarsal segment); caudal filaments long, stout and without a swollen pouch-like structure on the dorsal side of each filament....*indentatus* (Hald.), p. 506

8A. Front tarsal claws as long or longer than the terminal tarsal segment; caudal filaments long, broad, and with a swollen-like structure on the dorsal side of each filament..*herberti* n. sp., p. 507

Abedus signoreti Mayr, 1871

(Plate XLIX, fig. 2)

1871. *A. signoreti* Mayr. Verh. Zool.-Bot. Ges. Wien, XXI, p. 404.
1871. *A. vicinus* Mayr. Verh. Zool.-Bot. Ges. Wien, XXI, p. 405.
1901. *A. signoreti* Mayr. Champion, Biol. Centr. Am., Heter., II, p. 363, pl. 21. (Says *A. vicinus* Mayr is synonym.)

Size. (Ten specimens measured). Average length from the front of the eyes to the tip of the abdomen, 24.3 mm., average width, between inner posterior border of the eyes 2.7 mm., width of head including the eyes 6 mm., width of anterior portion of prothorax 7 mm., width of posterior border of metathorax 9.3 mm., greatest width about midlength of hemelytra 13.7 mm.

Color. Dorsal side: color varies from light brown to dark brown; with head, prothorax, scutellum, and membrane darkest of all. Ventral side: tibiae of forelegs with two wide, yellow crossbands on the outer surface; abdominal venter glabrous, yellowish-brown, the operculum finely punctate; pleural region covered with light to dark brown hairs; caudal filaments yellow, long and slender.

Structural Characteristics. Antennae slender, three- or four-segmented with the second and third segments each extending into a long and curved prolongation which is about intermediate in length between those of *A. ovatus* Stal and *A. breviceps* Stal; the membrane of the hemelytra with several closed cells, and 2.5 mm. in width at its widest point; metaxyphus strongly keeled; caudal filaments long and slender and covered with long hairs.

Types. Mayr, 1871, in his description fails to designate types. He merely states that there are two specimens from Mexico and one from Guatemala in the Museum at Stockholm in Signoret's collection. However, Champion (1901) says, "with types of *A. signoreti* Mayr ♀ and *A. vicinus* (Mayr) ♂ before me. . . ."

H. B. Hungerford, 1928, while examining entomological collections in Europe, compared the specimens of these species in the Museum at Stockholm and Vienna with specimens from the Francis

Huntington Snow Entomological Collection of the University of Kansas. He tells me that he agrees with Champion, 1901, that *A. vicinus* Mayr and *A. signoreti* Mayr are the same species.

Comparative Notes. This is one of the smallest species in the genus, and can be separated from the other two small species, *A. ovatus* Stal and *A. breviceps* Stal, by the glabrous venter, wide membrane, antennae, and caudal filament characters as shown by Plate XLIX, fig. 2; Plate L, fig. 7; Plate LI, fig. 4.

Data on Distribution. Mayr, 1871, mentions the fact that there is one specimen in Signoret's collection labeled from Guatemala.

I have seen the following in the Francis Huntington Snow Entomological Collection: Mexico: Rio de las Balsas, Guerrero, Hobart Smith 1932; Colima, Dr. O. Staudinger 1929. Central America: El Salvador, R. A. Stirton; San Jose, Costa Rica, H. Schmidt 1932; Rio Virilla, Costa Rica, H. Schmidt 1931. Panama: Chiriqua, Staudinger 1912; Patria? From the United States National Museum, Washington, D. C.: One specimen labeled "Victoria, Tamaulipas XII-10-09, Mex., F. C. Bishop collector." Another specimen is labeled "Rio Acelhuate, San Salvador, Salvador, 1-21-24, Hildebrand collector."

Abedus ovatus Stal, 1862

Plate XLIX, fig. 1

1862. *A. ovatus* Stal. Stet. Ent. Zeit., XXIII, p. 461.

1863. *Stenoscytus* Mayr. Verh. Zool.-Bot. Ges. Wien, XIII, pp. 343-347, Pl. II, figs. 6-10.

1863. *S. mexicanus* Mayr. Verh. Zool.-Bot. Ges. Wien, XIII, p. 347, Pl. II, figs. 6-10.

1901. A. *ovatus Stal.* Champion, Biol. Centr. Amer., Heter., II, p. 363, Pl. 21, fig. 19. (Says *S. mexicans* Mayr is synonym.)

Size. (Ten specimens measured.) Average length from the front of the eyes to the tip of the abdomen 24.9 mm., average width of head between inner posterior border of the eyes 3 mm., width of head including the eyes 6.4 mm., width of anterior portion of prothorax 6.9 mm., width of posterior border of metathorax 9.5 mm., greatest width about midlength of hemelytra 14.6 mm.

Color. Dorsal side: dusky brown, varying from dark to somewhat lighter shades in different specimens; with head, prothorax, and scutellum darker brown. Ventral side: tibiae of forelegs with two yellow crossbands on the outer surface; similar bands may be seen on the tibiae of the middle and hind legs of some specimens; abdominal venter entirely pubescent except for an elongated inverted V-shaped glabrous area along the median ridge; the hairs covering the abdominal venter are of a light brown to a dark grayish color; caudal filaments with black hairs.

Structural Characteristics. Antennae slender, three- or four-segmented, having on the second and third segments a short, straight prolongation which is shorter than the antennal prolongations of *A. breviceps* Stal and *A. signoreti* Mayr; the membrane of the hemelytra without any closed cells and .5 mm. at its widest point; metaxyphus strongly keeled; caudal filaments broad and stout, with a swollen pouch-like membrane on the dorsal side of each filament as shown on Plate LI, fig. 7.

Types: Stal, 1862, in his description of this species does not designate types. He states that the specimens are in the Museum at Stockholm, and in the collection of Signoret. He says nothing of the habitat of this species, except that the work in which the description was published is called "Hemiptera Mexicana." Mayr, 1863, says that specimens of *Stenoscytus mexicanus* (Mayr) may be found in the "Kaiserliche Zoölogische Museum at Wien," and in his collection from Mexico; and for *Abedus ovatus* Stal he says that specimens from Mexico are found in the Museum in Stockholm and Museum in Vienna, in the collection of Signoret, Fieber, and Mayr. H. B. Hungerford, 1928, while examining entomological collections in Europe, says the following about a specimen which is in the Museum at Stockholm: "the specimen has an old paper label 'ovatus Stal' 'Mexico' 'Signt.' It must be the type."

Comparative Notes. This is one of the smallest species that has been described in the genus, and can be separated from the other small species—*A. signoreti* Mayr, *A. breviceps* Stal—by the presence of an elongated inverted V-shaped bare area along the median ridge on the abdominal venter (Pl. XLIX, fig. 1); with a short, straight prolongation from the second and third segments (Pl. L, fig. 4); and caudal filament characters as shown on Plate LI, fig. 7.

Data on Distribution. Champion, 1901, gives the following data: "North America—Arizona, Texas, Lower California. Mexico: Xauripa in Guerrero, and Jalapa.

I have seen the following in the Francis Huntington Snow Entomological Collection: Mexico: Real de Arriva District of Temascaltepec, H. E. Hinton 1933. San Cristobal, 1920 and 1929.

Abedus breviceps Stal, 1862

(Plate XLIX, fig. 3)

1862. *A. breviceps* Stal. Stet. Ent. Zeit., XXIII, p. 462.
1871. *A. breviceps* Stal. Mayr, Verh. Zool.-Bot. Ges. Wien, XXI, p. 404.
1901. *A. breviceps* Stal. Champion, Biol. Centr. Am., Heter., II, p. 363, Pl. 21, fig. 20.

Size. (Ten specimens measured.) Average length from the front of the eyes to the tip of the abdomen 26.08 mm.; average width, between inner posterior border of the eyes 3 mm., width of head including the eyes 6.5 mm.; width of anterior portion of prothorax 6.8 mm.; width of posterior border of metathorax 10.4 mm.; greatest width about mid-length of hemelytra 15.6 mm.

Color. Dorsal side: color varies from a light brown to a dark brown; with head, prothorax, and scutellum reddish-brown. Ventral side: tibiae of forelegs with two yellow crossbands on the outer surface; abdominal venter bare along the median ridge but covered with reddish-yellow hairs along the pleural border, the hairs on the pleural area lighter in color; caudal filaments with dark brown and yellow hairs.

Structural Characteristics. Antennae slender, three- or four-segmented, having on the second and third segments a long, curved prolongation which is longer than the prolongations on the antennae of *A. signoreti* Mayr; the membrane of the hemelytra with a few closed cells and 1.7 mm. at its widest point; metaxyphus strongly keeled; caudal filaments broad and stout, and without a swollen pouch-like structure on the dorsal side of each.

Types. Stal, 1862, in his description of this species does not designate types. He states that the specimens are in the Museum at Stockholm, and in the collection of Signoret. He gives no locality of the specimens he described, except that the work in which the description was published is called "Hemiptera Mexicana." Mayr, 1863, gives as location of some specimens the Museum at Stockholm in Signoret's collection and in the Museum at Vienna. H. B. Hungerford, 1928, while examining entomological collections in Europe, compared some specimens of *A. breviceps* Stal from the Francis Huntington Snow Entomological Collection at the University of Kansas with specimens of that species found in the Museum at Stockholm and in the Museum at Vienna.

Comparative Notes. This is one of the smallest species in the genus, and can be separated from the two other small species, *A. signoreti* Mayr and *A. ovatus* Stal, by the presence of hair along the border of the abdominal venter (Pl. XLIX, fig. 3); antennae as shown in Plate L, figure 8; and caudal filament characters as shown by Plate LI, figure 2.

Data on Distribution. Champion, 1901, gives the following location for this species. Mexico: Cuernavaca.

I have seen the following in the Francis Huntington Snow Entomological Collection at the University of Kansas: Mexico: Tejupilco, H. E. Hinton 1933; Tarandacuao, Hobart Smith 1932; San Antonio, P. A. Readio 1927, L. D. Anderson 1927, and Stevenson 1927; Real de Arriva District of Tema-scaltepec, H. E. Hinton 1933. United States: Arizona, Cochise Co., L. D. Anderson 1927; Texas, Valentino, L. D. Anderson 1927, and R. H. Beamer 1927. From the United States National Museum, Washington, D. C. One specimen labeled "Mex. 2499, Collection of C. F. Baker." Another specimen "P. R. Uhler, Collection."

Abedus dilatatus (Say), 1832

(Plate LI, fig. 8)

1832. *Belostoma dilatatus* (Say). Heter., N. Harm., p. 38; Fitch Reprint, p. 810; Compl. Writ., I, p. 366.

1862. *Serphus* Stal. Stet. Ent. Zeit., XXIII, p. 462.

1862. *Serphus dilatatus* (Say). Stal, Stet. Ent. Zeit., XXIII, p. 462.

1871. *Serphus dilatatus* (Say). Mayr, Verh. Zool.-Bot. Ges. Wien, XXI, p. 403.

1897. *Deinostoma dilatatus* (Say). Kirkaldy, Entomologist, XXX, pp. 258-259.

1901. *Deinostoma dilatatus* (Say). Champion, Biol. Centr. Am., Heter., II, p. 362, Pl. XXI, fig. 18-18a.

Size. Length of body from the front of the eyes to the tip of the abdomen (male) 29 mm., (female) 25 mm.; width between inner posterior border of the eyes (male) 3 mm., (female) 2.9 mm.; width of head including the eyes (male) 7 mm., (female) 7 mm.; width of anterior portion of prothorax (male) 8 mm., (female) 7.5 mm.; width of posterior border of metathorax (male) 10.5 mm., (female) 9.5 mm.; greatest width about mid-length of hemelytra (male) 16 mm., (female) 14.2 mm.

Color. Dorsal side: the color of this species varies, some specimens being light brown and others being dark grayish-brown, with head, prothorax, and scutellum darkest of all. Ventral side: tibiae of the forelegs with two narrow, light yellow crossbands on the outer surface; venter covered with light yellow, reddish-brown, or dark brown, velvety hairs; pleural area covered with lighter colored hairs; caudal filaments covered with brown hairs and a band of dark hairs crossing each filament beyond the middle.

Structural Characteristics. Antennae three-segmented with a short prolongation from the second segment and none from the third segment; membrane of hemelytra with conspicuous closed cells and 1.3 mm. at its widest point; metaxyphus keeled; caudal filaments broad, stout and covered with long hairs. Each filament has a swollen pouch-like structure on the dorsal side about mid-length.

Types. Say, 1832, in his description of *Belostoma dilatatus* does not mention anything about types or their location, if there are any. Stal, 1862, mentions the Museum at Stockholm as the location of some specimens of *Serphus dilatatus* (Say). Mayr, 1863, says that there are six males and five females of this species located in the Museum at Stockholm, and also other specimens in the Museum at Vienna.

Comparative Notes. This species is about the same size as *A. signoreti* Mayr, *A. breviceps* Stal, and *A. ovatus* Stal, but it can be separated from them by the entirely pubescent venter; three-segmented antennae with or without a definite prolongation from the second segment and none from the third segment (Pl. L. fig. 6); and the caudal filaments with a swollen pouch-like structure on the dorsal side of each filament about the middle. It differs from *A. montandoni* De Carlo in that *A. dilatatus* (Say) has the metaxyphus keeled.

Data on Distribution. Champion gives the following on distribution: "North America—California, Lower California, and Arizona. Mexico—Tacubaya, San Bartolo, Puebla, and between Vera Cruz and Jalapa."

I have seen the following in the Francis Huntington Snow Entomological Collection at the University of Kansas. Mexico: Michoacan, Zitacuaro; Tarandacuao, Hobart Smith 1932. United States: Utah, St. George, L. A. Woodbury, collector.

Abedus macronyx (Mayr), 1863

(Plate L, fig. 2)

1863. *Pedinocoris macronyx* Mayr. Verh. Zool.-Bot. Ges. Wien, XIII, p. 350, Pl. II, figs. 1-4.

1863. *Pedinocoris* Mayr. Verh. Zool.-Bot. Ges. Wien, XIII, pp. 347-350, Pl. II, figs. 1-5.

1871. *Pedinocoris macronyx* Mayr. Verh. Zool.-Bot. Ges. Wien, XXI, p. 405.

1901. *Pedinocoris macronyx* Mayr. Champion, Biol. Centrali-Amerciana, Heter., II, p. 364.

Size. Male (one specimen in the Francis Huntington Snow Entomological Collection, University of Kansas), length from the front of the eyes to the tip of the abdomen 37.1 mm., width of head between inner posterior border of the eyes 4.9 mm., width of head including the eyes 8.9 mm., width of anterior portion of prothorax 10 mm., width of the posterior border of metathorax 13 mm., greatest width about mid-length of hemelytra 22 mm., length of fore-tarsal claws 1.1 mm., length of terminal tarsal segment 1 mm., length of the second tarsal segment .8 mm.

Color. Dorsal side: yellowish-brown, with head, prothorax, and scutellum dark brown. Ventral side: tibiae of forelegs with two yellow crossbands on the outer surface; abdominal venter covered with dark brown, velvety hairs, which are reddish-brown on the pleural region.

Structural Characteristics. Antennae long, stout, three-segmented with no prolongation from any segment; membrane of hemelytra with closed veins and 2 mm. at its widest point; metaxyphus elevated, but not keeled; fore tarsal claw 1.1 mm. in length.

Types. Mayr, 1863, gives the "Kaiserliche Zoologische Museum" as the location of a specimen, but does not mention the type. Mayr, 1871, states that he has specimens of this species in his collection.

Comparative Notes. This is the largest species of the genus and can be separated from the other large species, *A. indentatus* (Hald.) and *A. hungerfordi* De Carlo, by the antennal and fore-tarsal characters given in the key to the species on pp. 497 and 498.

Data on Distribution. Mayr, 1863 and 1871, gives California as the habitat of this species.

Champion, 1901, adds the following localities: Mexico: Rio Mescales, Cuesta de Miscantla, and Jalapa. Lower California.

I have seen the following in the Francis Huntington Snow Entomological Collection at the University of Kansas: Arizona, F. H. Snow 1902. From the United States National Museum, Washington, D. C.: "Reddington, Arizona, Dr. W. Barnes, dedit."

Abedus montandoni De Carlo, 1932

(Plate L, fig. 5)

1932. *Abedus montandoni* De Carlo. Revista De La Sociedad Entomologica Argentina, No. 22, Nov. 30, pp. 121-123, Pl. V, figs. 5-6.

Size. Length of body from the front of the eyes to the tip of the abdomen 26 mm.; width between inner posterior border of the eyes 3.3 mm.; width of head including the eyes 7 mm.; width of anterior portion of prothorax 7 mm.; width of posterior border of metathorax 9.5 mm.; greatest width about mid-length of hemelytra 15 mm.

Color. Dorsal side: light to dark brown; with head, prothorax, and scutellum darkest of all in some specimens. Ventral side: tibiae of forelegs with two light-yellow crossbands on the outer surface; abdominal venter covered with dark brown, velvety shiny hairs; pleural area covered with reddish brown, shiny hairs; and the connexiva light yellow.

Structural Characteristics. Antennae three-segmented, the second segment with a short prolongation; the membrane of the hemelytra with conspicuous closed cells, and 1.5 mm. at its widest point; metaxyphus elevated but not strongly keeled; caudal filaments without a swollen pouch-like structure on the dorsal side of each.

Types. Holotype, male; allotype, female; eight paratypes; Zinacantepec, Mexico, A. Spegazzini, collector. Holotype, allotype, and seven paratypes are in the Natural History Museum of Buenos Aires, catalogued under number 30432. One paratype is located in the Francis Huntington Snow Entomological Collection, University of Kansas, Lawrence, Kansas.

Comparative Notes. This species resembles *A. signoreti* Mayr, *A. breviceps* Stal, and *A. ovatus* Stal, in size and also in color, but can be distinguished from them by its entirely pubescent abdominal venter, and its metaxyphus which is not strongly keeled. It is smaller than *A. macronyx* (Mayr).

Data on Distribution. De Carlo, 1932, in his description of this species, gives as its habitat, Mexico: Zinacantepec, A. Spegazzini, collector.

I have seen the following in the Francis Huntington Snow Entomological Collection, Arizona, F. H. Snow. Mexico: Zinacantepec, A. Spegazzini collector.

Abedus hungerfordi De Carlo, 1932

(Plate L, fig. 9)

1932. *Abedus hungerfordi* De Carlo. Revista De La Sociedad Entomologica Argentina, No. 22, Nov. 30, pp. 123-124, Pl. V, figs. 3-4.

Size. (Ten specimens measured). Average length from the front of the eyes to the tip of the abdomen 34.5 mm.; width between inner posterior border of the eyes 3.4 mm.; width of head including the eyes 8 mm.; width of anterior portion of prothorax 9 mm.; width of the posterior border of metathorax 12 mm.; greatest width about mid-length of hemelytra 18.9 mm.

Color. Dorsal side: the color of this species varies from a light brown to a dark, grayish-brown, with head, prothorax, and scutellum darkest of all. Ventral side: tibiae of forelegs with two narrow, light-yellow crossbands on the outer surface; abdominal venter covered with velvety dark brown or reddish hairs; caudal filaments light yellow with a narrow band of dark hairs crossing each filament beyond the middle.

Structural Characteristics. Antennae stout, four-segmented, the second and third segments with a prolongation as in *A. ovatus* Stal, *A. signoreti* Mayr, and *A. breviceps* Stal; the membrane of the hemelytra with many closed cells and 2.5 mm. at its widest point; metaxyphus broadly elevated but not keeled; caudal filaments broad, stout, and covered with long hairs, and without a swollen pouch-like structure on the dorsal side of each.

Types: Holotype, male; allotype, female; six paratypes; one allotopotype, female; Alpine, California, L. D. Anderson, collector, July 9, 1929. Four paratypes, females, one allotopotype, female, and a holotype are located in the Francis Huntington Snow Entomological Collection, University of Kansas, Lawrence, Kansas. Three paratypes are located in the Museum of Natural History of Buenos Aires, catalogued under number 30433.

Comparative Notes. This is one of the largest species of the genus, and can be separated from the other large species, *A. dilatatus* (Say), *A. indentatus* (Hald.), and *A. herberti* n. sp., by the antennae (Pl. L, fig. 9); caudal filaments (Pl. LI, fig. 6); and fore-tarsal claw characters as given in the key to the species on pp. 497 and 498.

Data on Distribution. I have seen the following in the Francis Huntington Snow Entomological Collection, University of Kansas. California: Alpine, L. D. Anderson 1929, and R. H. Beamer 1929; Laguna Mts., L. D. Anderson 1929; San Diego Co., R. H. Beamer 1929; Campo, H. W. Capps 1932; Indio, P. W. Oman 1929. Arizona: Santa Rita Mts., R. H. Beamer 1932, and L. D. Anderson 1929, and F. H. Snow; Huachuca Mts., R. H. Beamer 1927; Yavapai Co., P. A. Readio 1927; Chiricahua Mts., R. H. Beamer 1932; Pima Co., P. A. Readio 1927; Gila Co., P. A. Readio 1927; Sabino Canyon, Painter 1932.

Abedus indentatus (Hald.), 1853

(Plate LI, fig. 3)

1853. *Zaitha indentatus* Hald. Proc. Acad. Sci. Phila., VI, p. 364.
1863. *Pedinocoris brachonyx* Mayr. Verh. Zool.-Bot. Ges. Wien, XIII, p. 351.
1871. *Pedinocoris brachonyx* Mayr. Verh. Zool.-Bot. Ges. Wien, XXI, p. 405.
1877. *Abedus indentatus* (Hald.). Uhler, Wheeler's Rept. Chief Eng., p. 1331.
1900. *Abedus* Stal. Montandon, Bul. Sci. Bucharest, IX, Nos. 2, 3, p. 11.

Size. Female (one specimen in the collection): Length from the front of the eyes to the tip of the abdomen 35 mm.; width of head between inner posterior border of the eyes 3.5 mm.; width of anterior portion of prothorax 9 mm.; width of head including the eyes 8 mm.; width of the posterior border of the metathorax 13 mm.;

greatest width about mid-length of hemelytra 20 mm.; length of fore-tarsal claws .4 mm.; length of terminal fore-tarsal segment 1.1 mm.; length of the second fore-tarsal segment .9 mm.

Color. Dorsal side: yellowish-brown. Head, prothorax, mesothorax, and scutellum speckled with irregular dark-brown spots. Membrane of the hemelytra dark brown. Ventral side: tibiae of forelegs with two yellow crossbands on the outer surface, abdominal venter entirely pubescent with dark brown, reddish, velvety hairs. The caudal filaments covered with brown hairs.

Structural Characteristics. Antennae long and stout, four-segmented with a short, straight prolongation on the second and third segments. Membrane of hemelytra with closed cells and 2.9 mm. in width at its widest point. Metaxyphus broad and slightly elevated. Caudal filaments broad, stout, and covered with long hairs, and without a swollen pouch-like structure on the dorsal side of each.

Types. There is no information about types. Mayr, 1863, gives as the location of one specimen of this species "Kaiserliche Zoölogische Museum." Mayr, 1871, gives the Museum at Vienna as the location of specimens of this species.

Comparative Notes. This species is about the largest in the genus, but can be separated from the two other large species, *A. hungerfordi* De Carlo and *A. dilatatus* (Say), by antennae (Pl. L, fig. 3); metaxyphus; caudal filaments (Pl. LI, fig. 3); and fore-tarsal claw characters as given in the key to the species on pp. 497 and 498.

Data on Distribution. Mayr, 1863 and 1871, gives California as the place of collection of the specimens which are located in the "Kaiserliche Zoölogische Museum in Wien."

I have seen one specimen which is in the Francis Huntington Snow Entomological Collection, University of Kansas. Arizona: Ft. Grant, 1917. One specimen from the United States National Museum, Washington, D. C., which has no label.

Abedus herberti, n. sp.

(Plate LI, fig. 1)

Size. Male: Length from the front of the eyes to the tip of the abdomen 29 mm.; width of head between inner posterior border of the eyes 3 mm.; width of head including the eyes 7 mm.; width of anterior portion of prothorax 7 mm.; width of the posterior border of metathorax 10.5 mm.; greatest width about mid-length of hemelytra 16.5 mm.; length of fore-tarsal claws 1 mm.; length of terminal fore-tarsal segment .9 mm.; length of second fore-tarsal segment 5 mm. Female: Similar to male in all measurements except length from the front of the eyes to the tip of the abdomen, which is 30 mm., and width of head between inner posterior border of the eyes, which is 4 mm.

Color. Dorsal side: dark, yellowish-brown. Head speckled with small, irregular darker brown spots. Prothorax, mesothorax, and scutellum nearly covered with dark brown irregular specks, except for a spindle-shaped, yellowish area extending from the posterior part of the prothorax and ending at the anterior border of the scutellum. An irregular dark yellow area extends from the anterior border to the posterior border on the median line of the prothorax. Ventral side: tibiae of forelegs and middle legs with two yellow crossbands on the outer surface. Abdominal venter entirely pubescent with dark brown, velvety hairs, which are reddish-brown along the border of the venter and also in the pleural region. Connexiva translucent yellow. Caudal filaments light yellow and a band of dark hairs crossing each filament beyond the middle.

Structural Characteristics. Antennae long and stout, three-segmented, having a short, straight prolongation on the second and third segments. The prolongations are shorter than those in the antennae of *A. breviceps* Stal, *A. signoreti* Mayr, and *A. ovatus* Stal; membrane of the hemelytra with closed cells and 1.8 mm. at its widest point; metaxyphus elevated but not keeled; caudal filaments broad, stout, and covered with long hairs. Each filament with an elongated, swollen pouch-like membrane on the dorsal side as shown on Plate LI, figure 1.

Types. Holotype, male; allotype, female; five paratypes, Arizona; F. H. Snow, collector. These are located in the Francis Huntington Snow Entomological Collection, University of Kansas, Lawrence, Kansas.

Comparative Notes. This species may be confused in size with *A. breviceps* Stal, *A. signoreti* Mayr, and *A. ovatus* Stal, but may be separated from them by antennae (Pl. L, fig. 1); metaxyphus; abdominal venter; membrane of the hemelytra; and caudal filament characters as given in the key to the species on pp. 497 and 498.

Data on Distribution. The Francis Huntington Snow Entomological Collection has specimens of this species from Arizona, F. H. Snow, collector. One specimen from the United States National Museum, Washington, D. C., labeled "Arizona, P. R. Uhler Collection."

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5. DUFOUR, L. 1863. Ann. Soc. Ent. Fr., ser. 4, III, p. 395, *A. dilatatus* (Say); pp. 379, 395, *Deinostoma* Kirk.; pp. 379, 396, *Abedus* Stal.; p. 396, *A. ovatus* Stal; p. 396, *A. breviceps* Stal.
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9. ——— 1898. Entomologist, XXXI, p. 3, *A. macronyx* (Mayr).
10. ——— 1906. Trans. Am. Ent. Soc., XXXII, p. 151, *Abedus* Stal, *Deinostoma* Kirk., *Pedinocoris* Mayr.
11. KIRKALDY AND BUENO. 1908. Proc. Ent. Soc. Wash., X, p. 189, *Abedus* Stal.
12. MAYR, G. L. 1863. Verh. Zool.-Bot. Ges. Wien, XIII, pp. 341, 343, *Abedus* Stal; p. 347, pl. 11, figs. 6-10, *Stenoscytus* Mayr, *S. mexicanus* Mayr; pp. 347-350, pl. 11, figs. 1-5, *Pedinocoris* Mayr; p. 350, pl. 11, figs. 1-4, *Pedinocoris brachonyx* Mayr.
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15. ——— 1903. Bul. Soc. Sci. Bucarest, XII, pp. 110, 113, *Abedus* Stal; p. 113, *Deinostoma* Kirk.; p. 113, *Pedinocoris* Mayr.
16. SAY, T. 1832. Heter., N. Harm., p. 38; Fitch Reprint, p. 810; Compl. Writ., I, 366, *B. dilatatus* Say.
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18. ——— 1865. Hemip. Afr., III, p. 179, *Deinostoma* Kirk. (*Serphus* Stal); p. 180, *Abedus* Stal.
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PLATE XLIX

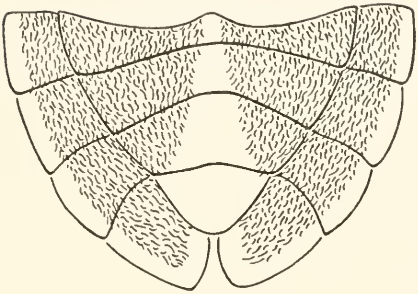
FIG. 1. Abdominal venter of *Abedus ovatus* Stal.

FIG. 2. Abdominal venter of *Abedus signoreti* Mayr.

FIG. 3. Abdominal venter of *Abedus breviceps* Stal.

The figures are to illustrate the extent of pubescence mentioned in the key on page 497.

PLATE XLIX



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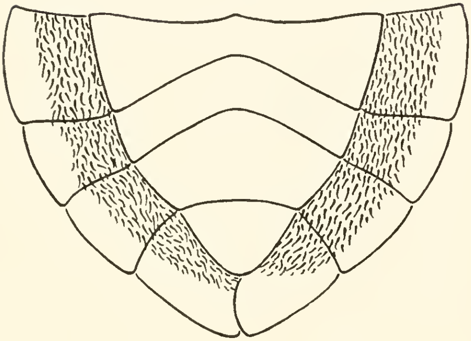
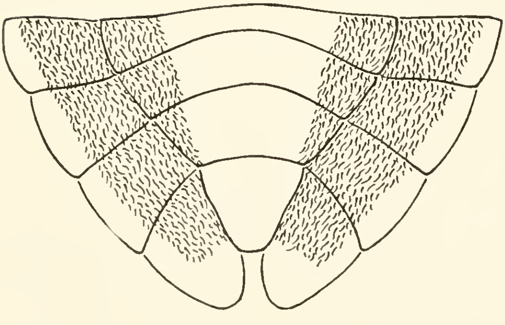


2. A. signoreti

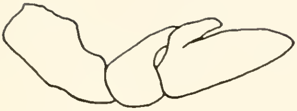


3. A. breviceps

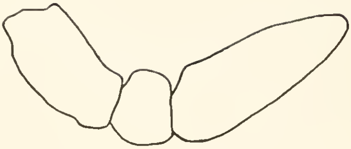
PLATE L

Fig. 1. Antenna of *Abedus herberti* Hidalgo.
Fig. 2. Antenna of *Abedus macronyx* (Mayr).
Fig. 3. Antenna of *Abedus indentatus* (Hald.).
Fig. 4. Antenna of *Abedus ovatus* Stal.
Fig. 5. Antenna of *Abedus montandoni* De Carlo.
Fig. 6. Antenna of *Abedus dilatatus* (Say).
Fig. 7. Antenna of *Abedus signoreti* Mayr.
Fig. 8. Antenna of *Abedus breviceps* Stal.
Fig. 9. Antenna of *Abedus hungerfordi* De Carlo.

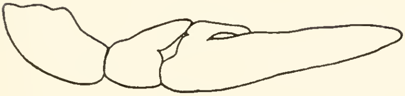
PLATE L



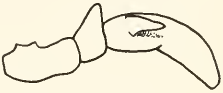
1. A. herberti



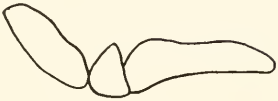
2. A. macronyx



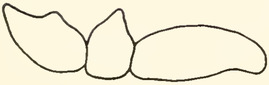
3. A. indentatus



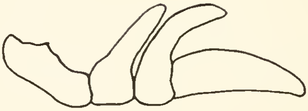
4. A. ovatus



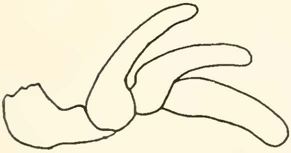
5. A. montandoni



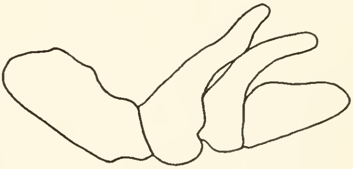
6. A. dilatatus



7. A. signoreti



8. A. breviceps



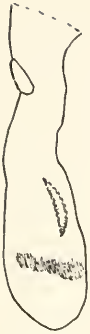
9. A. hungerfordi

PLATE LI

FIG. 1. Retractile caudal filament of *Abedus herberti* Hidalgo.
FIG. 2. Retractile caudal filament of *Abedus breviceps* Stal.
FIG. 3. Retractile caudal filament of *Abedus indentatus* (Hald.).
FIG. 4. Retractile caudal filament of *Abedus signoreti* Mayr.
FIG. 5. Retractile caudal filament of *Abedus montandoni* De Carlo.
FIG. 6. Retractile caudal filament of *Abedus hungerfordi* De Carlo.
FIG. 7. Retractile caudal filament of *Abedus ovatus* Stal.
FIG. 8. Retractile caudal filament of *Abedus dilatatus* (Say).

At the base or upper end of each of these filaments will be seen the spiracle. Figures 7 and 8 show the swollen-like structure on the dorsal side of the filament mentioned in the key on page 497.

PLATE LI



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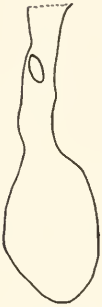
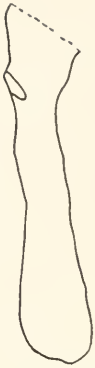
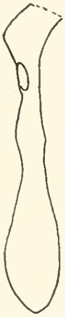


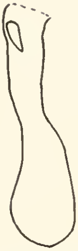
2. A. breviceps



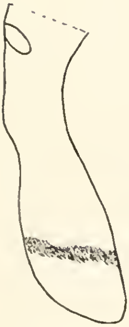
3. A. indentatus



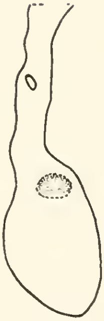
4. A. signoreti



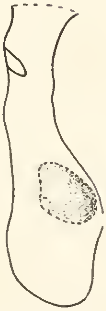
5. A. montandoni



6. A. hungerfordi



7. A. ovatus

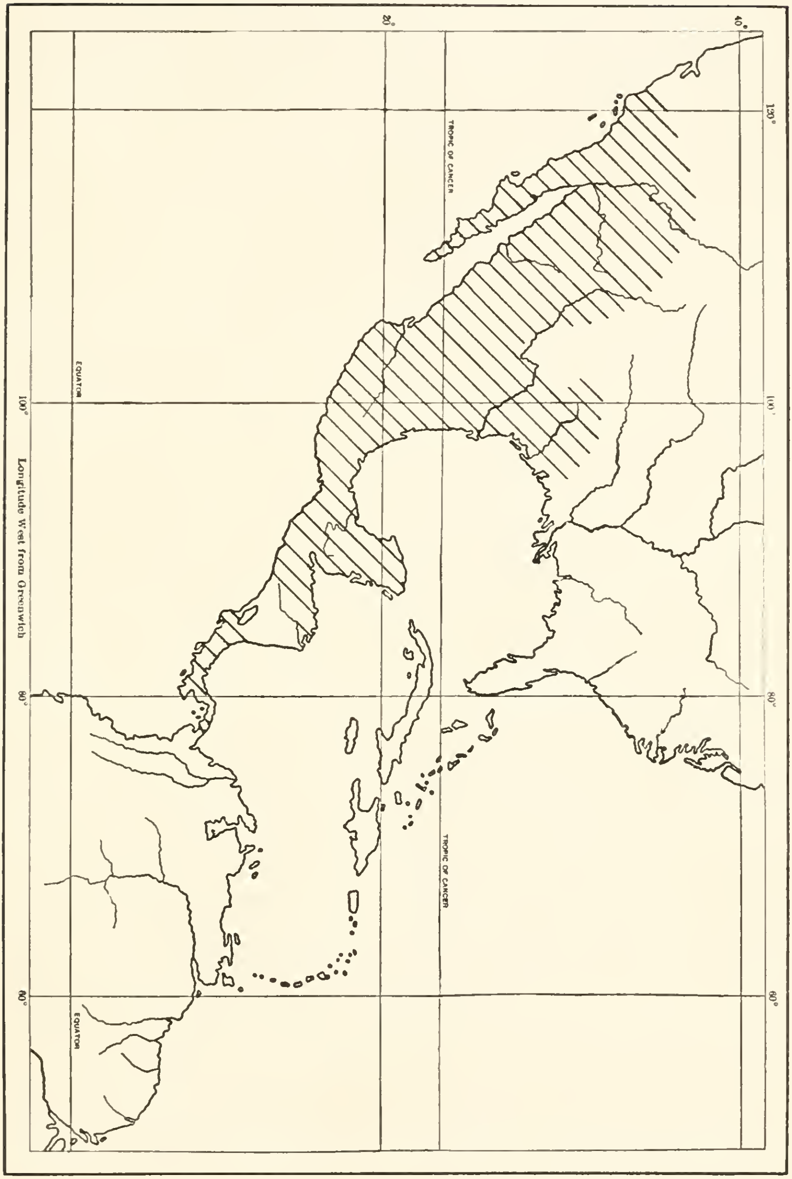


8. A. dilatatus

PLATE LII

Map showing the distribution of the genus Abedus Stal.

PLATE LII


20°
40°
120°
TROPIC OF CANCER
EQUATOR
100°
100°
Longitude West from Greenwich
80°
80°
TROPIC OF CANCER
60°
60°
EQUATOR

THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

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The Insect Tarsus

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TO THE student-entomologist of the American university the insect tarsus appears, at present, as an ill-defined feature, and a muddled terminology aggravates the situation. This paper, it is hoped, may serve to clarify the morphology of the insect tarsus.

Since the tarsus is a segment of the body-wall evagination producing the insect limb, it is probably to advantage that this discussion begin with the present conception of the origin of the insect leg. The prototype of the present insect leg was most probably well segmented, so it should be understood that the simple evagination represented by Plate LIII, figure 1, is a diagram of the protoarthropodan appendage. Stripped of their individual specializations the limbs of some annelids are rather similar in structural plan to that of figure 1.

Sclerotization of the pleura, and of the limbs themselves, involves the necessity of certain mechanical modifications, namely, the development of more or less persistent sclerites and articulations. Probably the first modification, after sclerotization, of the appendage of figure 1 was the division into a primary coxa (*pcs,* Pl. LIII, fig. 2) and a telopodite (*tlp*). Snodgrass believes the second modification of a divisional nature separated the telopodite of figure 2 into primary femur (*pfm,* Pl. LIII, fig. 3) and primary tibia (*ptb*). Basally from the primary femur the trochanter separated, and from the primary tibia the tarsus separated, which resulted in the probable primitive segmentation of the thoracic appendage of the insect-ancestor, as shown in Plate LIII, figure 4.

Paleontology offers only meager evidence, and ontogeny, as far as the university student is concerned, is no more explicit than paleontology concerning the development of the insect leg. The morphologist has to resort to comparative studies and to his imagination, guided by "common sense." If the preceding paragraph does not appear reasonable, the reader should study Snodgrass' paper on the insect head (Smithson. Rpt. for 1931, pages 465-467), and his paper on the thorax (Smithson. Misel. Col., v. 80, pages 72-98), in which he discusses the subject in detail. In this paper the tarsus is the object under scrutiny.

In figure 4, Plate LIII, the tarsus is represented as a single leg-segment, which is not the generalized condition in insects. The most generalized orthopterans have the tarsus with six subdivisions, each of which is adequately described by the term subsegment. That these subsegments are not individually equal in value to a segment such as the tibia or femur is indicated by the lack of muscles between the subsegments (see Pl. LIII, fig. 5). The base of *I* (Pl. LIII, fig. 5) usually has extensor (1) and flexor (2) muscles extending into and attached to the tibia, which suggests that the six tarsal articles are subdivisions of one segment.

Before establishing any conclusions, however, the flexor apparatus of the claws should be considered. Plate LIII, figure 6, shows the nature of this apparatus in longitudinal section. The unguitrator (*ugt*) is a sclerite at the ventral base of the distal-most tarsal subsegment, and has an invagination to which the unguiflexor tendon (u-t) is attached. The tendon extends into the tibia, and the unguiflexor muscle is not, usually, the basitarsal flexor. Such a condition does not materially aid deMeijere's idea of the two-segmented primary tarsus, but it also prevents the unconditional acceptance of the single-segmented primary tarsus, since muscles are known to shift origins, and since the attachment of the unguiflexor tendon to the unguitractor plate strongly suggests a flexor apparatus for the base of a true limb-segment.

Whether or not the tarsus is primarily two-segmented cannot be settled at the present time, but something can be done towards rectifying other conceptions of the insect tarsus. Even if deMeijere's idea proves to be correct, his term "pretarsus" is not a fortunate one. Distitarsus is more definitive.

Before considering more terminological alterations, the morphology of the distitarsus should be made clear. Figure 7, Plate LIII, is a diagram illustrating that the claws are essentially evaginations of the distitarsal cuticula. The sclerotization of these evaginations, and the unguiflexor apparatus make it mechanically necessary that the claws articulate against some firm feature, and the dorsodistal rim of the preceding subsegment is a convenient point for such an articulation.

The median portion of the distitarsus then becomes a cushion-like structure between the claws, and, in place of "arolium" (the Latin for a roll of cloth!) the term pulvillus is suggested. It is here acknowledged that the term pulvillus has been used for the paired pads beneath the claws of certain insects, but since these paired pads are most probably ventrolateral evaginations of the median pulvillus why is not the term parapulvillus better for the pad beneath the claw?

As for the term "empodium" it is not needed, since it is recognized by most morphologists as an elongated process of the unguitractor (Pl. LIII, fig. 8). It is hardly sensible to have two terms for one structure.

Comparative ontogenetical studies may furnish evidence for the correct interpretation of the tarsus, but until the results of such studies are made available this simple interpretation and term revision is contributed especially to the university student-entomologist.

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——— 1931. Evolution of the insect head. Smithson. Rpt. 1931, pp. 465-467.

ABBREVIATIONS

a—dorsal or chief articulatory point of coxa.
app—appendage
b—ventral or accessory articulatory point of coxa.
cla—claw
cx—coxa
fm—femur
m—membrane
pcx—primary coxa
pfm—primary femur
pln—pleuron
ppul—parapulvillus
scl—sclerite
tar—tarsus
tb—tibia
tlp—telopodite
tr—trochanter
ugt—unguitractor
u-t—unguiflexor tendon

PLATE LIII

FIG. 1. Hypothetical appendage, based upon fundamental annelidan appendage.

FIG. 2. Sclerotized hypothetical appendage.

FIG. 3. Sclerotized hypothetical appendage with primary leg-segments leading to the insect type.

FIG. 4. General plan of the insect leg.

FIG. 5. Left half of tarsus, from sagittal plane, with the subsegment condition as in generalized Orthoptera.

FIG. 6. Left half of distitarsus, from sagittal plane.

FIG. 7. Ventral half of distitarsus from inner view.

FIG. 8. A—Dorsal view of grasshopper distitarsus. B—Ventral view of grasshopper distitarsus.

FIG. 9. Ventral view of an asilid distitarsus.

FIG. 10. Ventral view of a tabanid distitarsus.

PLATE LIII

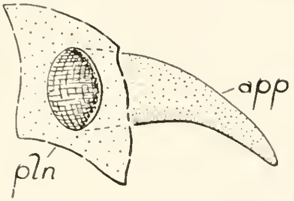


Fig. 1

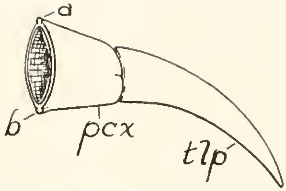


Fig. 2

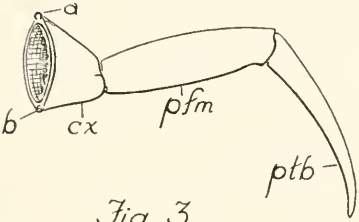
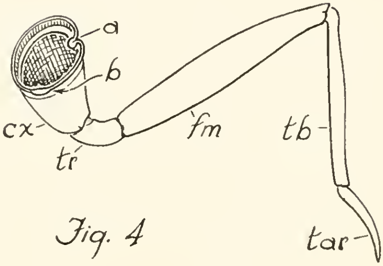

a
b
cx
pfm
ptb

Fig. 3


a
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tar

Fig. 4

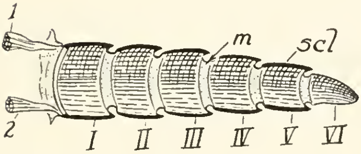
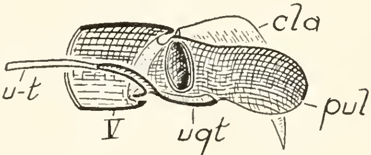

1
m
scl
2
I
II
III
IV
V
VI

Fig. 5


cla
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V
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Fig. 6

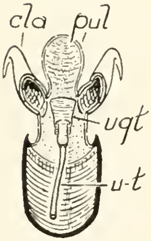
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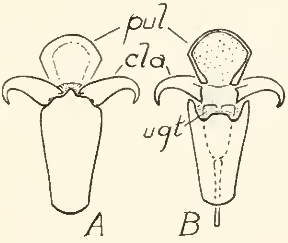
Fig. 7


pul
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A
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Fig. 8

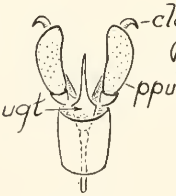
cla
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Fig. 9

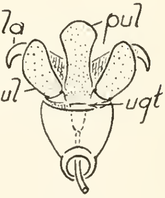

Fig. 10

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A Monograph of the Genera Alapus and Hebecephalus (Cicadellidae Homoptera)

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ABSTRACT: North American (north of Mexico) species of the genera ALAPUS and HEBECEPHALUS are reviewed and the following new species described: *A. acutus, A. elongatus, A. angulatus, H. furcilliatus, H. rostratus, H. sagittatus, H. truncatus, H. occidentalis, H. adversus. Hebecephalus signatifrons* var. *crassus* DeLong is raised to specific rank. *Hebecephalus obesus* (Osb. & Ball) is referred back to DELTOCEPHALUS. Drawings of male and female genitalia and keys to all species are included. Types of all new species are in the Snow Collection, University of Kansas, Lawrence, Kan.

INTRODUCTION

THIS paper is a review of the known species of the genera Alapus and Hebecephalus in North America north of Mexico, with the descriptions of nine new species. Thanks are due Dr. H. H. Knight of Iowa State College, Dr. J. N. Knull of Ohio State University and Mr. Maurice James of the Colorado Agricultural College for the loan of type material.

THE GENUS ALAPUS DELONG

The genus Alapus was erected in 1929 by DeLong and Sleesman (Annals Ent. Soc. Am. p. 86, vol. XXII, 1929) to receive *Deltocephalus fraternus* Ball and *Deltocephalus mendosus* Ball. Since the genus has been more than doubled and we are adding three new species at this time, making a total of seven, we are giving a key to separate the various forms.

KEY TO THE SPECIES OF ALAPUS

1. Male pygofer about twice as long as plates.................................. 2
   Male pygofer much shorter, not over one and one half as long as plates......... 3
2. Male plates exceeding the valve by almost its length; posterior margin of last ventral segment of female shallowly excavated............*attenuatus* Lawson, p. 529
   Male plates much shorter, exceeding valves by one third its length; posterior margin of last ventral segment of female deeply excavate......*elongatus* n. sp., p. 531

3. Styles long, tips usually visible at apex of plates.............................. 4
Styles short, never visible at apex of plates.................................. 6

4. Valve very long and acute, almost as long as plates; whole posterior margin of plates membranous and shriveled in appearance; last ventral segment of female smoothly excavated to pair of large median teeth. *marcidus* Beamer and Tuthill, p. 529
Valve much shorter; posterior margin of last ventral segment of female with small or no median teeth.. 5

5. Large species 3.5-4 mm.; outer third of style with sides almost straight and parallel; posterior margin of last ventral segment of female with two teeth. *angulatus* n. sp., p. 529
Smaller species 3-3.5 mm.; outer third of style crescent-shaped; posterior margin of last ventral segment of female without teeth.............*mendosus* (Ball), p. 530

6. Male plates rounding to rather blunt apices; posterior margin of last ventral segment of female concavely excavated to two prominent median teeth. *fraternus* (Ball), p. 528
Male plates obliquely truncated to sharp apices; posterior margin of last ventral segment of female almost straight, median teeth not prominent...*acutus* n. sp., p. 528

Alapus fraternus (Ball)

Deltocephalus fraternus Ball, E. D., Can. Ent. XLIII, p. 102, 1911.

This is a very common Florida species. The study of many specimens leads one to the conclusion that there is quite a variation in the posterior margin of the last ventral segment of the female. Dissections of males, however, reveal quite constant characters.

Internal Genitalia. Oedagus very small. Styles large and broad, never reaching apex of plates, with quite long and slender lateral processes near outer third; slightly curved on inner margin, tips truncate, outer margin longest.

Alapus acutus n. sp.

Resembling *A. fraternus* (Ball), but male plates with acute apices and female last ventral segment with posterior margin scarcely concave and very deep mesal slit. Length, 3.5-4 mm.

Color. Grayish-white with definite tawny tinge. Vertex with fuscous spots typical of Alapus, arcs of face visible. Pronotum flected with fuscous. Elytra with veins light, irregularly fuscous margined. Venter more or less fuscous.

Structure. Vertex about half again as long mesally as width between eyes, slightly concave before apex. Elytra slightly shorter than abdomen in females and usually about as long in males.

External Genitalia. Last ventral segment of female about one half as long again as preceding. Posterior margin scarcely concave, with deep mesal slit and two notches each side forming a pair of sharp median teeth and a broader, blunter one on each side. Male valve acute. Plates slightly broader than valve at base, outer margin slightly sinuate to apex of valve, then obliquely truncate to sharp apices. Pygofer usually exceeding plates by about half their length, basal tumosity not prominent.

Internal Genitalia. Styles much shorter than plates, with broad truncate apices and stout lateral processes.

Holotype, male; allotype female; 6 females and 8 males Estero, Fla., July 21, 1934, R. H. Beamer. Other paratypes as follows: 1 male and 4 females, Tampa, Fla., July 20, 1934, P. McKinstry; 1 male and 1 female, Bonita Springs, Fla., July 21, 1934, J. D. Beamer; 7 males, Fort Myers, Fla., Aug. 14, 1930, R. H. Beamer; 3 males, Fort Myers, Fla., Aug. 14, 1930, P. W. Oman.

Alapus attenuatus Lawson

Alapus attenuatus Lawson, Paul B., Jour. Kans. Ent. Soc., Jan., 1932, vol. 5, No. 1, p. 29.

This large species is quite easily recognized by the very long male pygofers, coupled with the distinctive shape and size of the male plates. The females are more easily confused with *A. fraternus,* from which they may usually be separated by the posterior margin of the last ventral segment of the female being slightly excavated with not prominent median teeth as compared with prominent lateral angles, deep excavation of posterior margin and prominent median teeth of fraternus.

Internal Genitalia. Oedagus inconspicuous. Styles not reaching apex of plates, inner margins almost straight, apices truncate.

Alapus marcidus Beamer and Tuthill

Alapus marcidus Beamer and Tuthill, Jour. Kans. Ent. Soc., vol. VII, p. 1, 1934.

This species is usually quite readily distinguished by the three-notched appearance of the posterior margin of the last ventral segment of the female. The males are more readily confused with *A. fraternus,* but may be separated by the shape of the male plates.

Internal Genitalia. Oedagus very small. Styles large, sometimes visible at tip of plates, outer third semisagittate, inner margin slightly curved, sides slightly converging.

Alapus angulatus n. sp.

Resembling *A. marcidus* B. & T., but with processes on outside of male style at about right angles to shaft, apex of plates more rounding, last ventral segment of female with mesal notch very narrow and shallow with very prominent keel below notch. Length, 3.5-4 mm.

Color. Grayish-white with tawny tinge. Vertex with usual five spots. Frontal arcs showing on margin. Pronotum irregularly flecked with fuscous. Elytra with veins light, irregularly fuscous margined. Face fuscous with definite light arcs mesally incomplete. Venter more or less fuscous.

Structure. Vertex rather acute, one third longer mesally than width between eyes. Elytra longer than abdomen in male, slightly exceeded by pygofer in female.

External Genitalia. Last ventral segment of female about one and one half times as long as preceding, posterior margin deeply concave with pair of sharp teeth bordering shallow, very narrow median slit, oval black spot almost reaching base of segment each side of prominent mesal keel. Male valve acute. Plates slightly wider than valve at base, outer margins straight to apex of valve, evenly rounded to apices, small rectangular apical portion of plates with withered appearance, often exposing tips of styles. Pygofer large, bulbous near base, heavy throughout, exceeding plates by about one fourth their length, decidedly stouter than in *A. marcidus.*

Internal Genitalia. Styles equalling plates in length with lateral processes at right angles to shaft midway between apex and point of attachment; apices truncate. Processes of pygofer much as in *A. marcidus.*

Holotype, male; allotype, female; two male and two female paratypes, Okefenokee Swamp, Georgia, Aug. 3, 1934, R. H. Beamer.

Alapus mendosus (Ball)

Deltocephalus fraternus var. *mendosus* Ball, E. D. Can. Ent., XLIII, p. 202, 1911.

This species, the smallest so far in the genus, is typically found in southern Florida. This past summer (1934) a fine series of both males and females was taken at Homestead, Fla., not associated with any other species in the genus. Another nice series was taken a few days earlier at Estero, Fla., the type locality of the species, but these were associated with the new species *A. elongatus,* making it somewhat difficult to separate the females. In general, the median notch in the posterior margin of the last ventral segment of mendosus is smoother and more pronounced.

Internal Genitalia. Oedagus inconspicuous. Style long, tips usually visible at apex of plates, outer third scimitar-shaped with quite rounded, narrow apices.

Alapus elongatus n. sp.

Resembling *A. mendosus* (Ball), but pygofer of male very long, twice as long as plates. Length, 3-3.5 mm.

Color. Grayish-white with tawny tinge. Vertex with fine fuscous spots. Arcs of face visible. Pronotum flecked with fuscous. Elytra with veins irregularly fuscous margined. Venter more or less fuscous.

Structure. Vertex acute, almost twice as long mesally as width between eyes. Elytra about as long as abdomen in male, reaching the pygofer in female.

External Genitalia. Last ventral segment of female deeply excavated on posterior margin with mesal slit almost reaching base of segment, three teeth on each side. Male valve acute, plates slightly wider than valve at base, outer margins almost straight to apex of valve, rounded to blunt apices, barely exceeding valve. Pygofer extremely heavy at base, exceeding plates by their length, and sharply tapered on apical half.

Internal genitalia. Styles slightly exceeding plates, apices rounding to point on outer margins, stout lateral processes forming crescents with curving apices.

Holotype, male; allotype, female; 5 female and 32 male paratypes, Estero, Fla., July 21, 1934, R. H. Beamer; one male paratype, Fort Myers, Fla., August 11, 1930, R. H. Beamer.

THE GENUS HEBECEPHALUS DELONG

There have been eleven species and one variety included in this genus up to the present time. This paper raises the variety *H. crassus* (DeL.) to specific rank, refers *H. obesus* (O. & B.) to the genus Deltocephalus, to which it evidently belongs, and adds six new species, most of which have been confused with *H. signatifrons* (Van D.). Type material of *H. signatifrons* (Van D.), *H. crassus* (DeLong), *H. discessus* (VanD.), *H. blandus* (Gill.), *H. cruciatus* (O. & B.), *H. scriptanus* Oman, *H. neomexicanus* Tuthill and *H. tener* Beamer and Tuthill was available for this study.

KEY TO THE SPECIES OF HEBECEPHALUS

1. Very light colored species; fuscous markings of vertex two longitudinal bands (except *cruciatus*); posterior margin of last ventral segment of female without large mesal notch 2
   Dark colored species; fuscous markings of vertex not in two longitudinal bands; posterior margin of last ventral segment of female with large mesal notch 7
2. Posterior margin of last ventral segment of female with median tooth 3
   Posterior margin of last ventral segment of female without median tooth 6

3. Posterior margin of last ventral segment of female evenly produced to small median tooth .... *scriptanus* Oman, p. 538

Posterior margin of last ventral segment of female sharply excavated each side of median tooth 4

4. Posterior margin last ventral segment of female with median tooth shorter than lateral lobes 5

Posterior margin last ventral segment of female with median tooth longer than lateral lobes .... *tener* Beamer and Tuthill, p. 537

5. Posterior margin of last ventral segment of female concavely sinuate to small median tooth .... *cruciatus* (O. & B.), p. 539

Posterior margin of last ventral segment of female deeply excavate to large median tooth .... *blandus* (Gill. & Bk.), p. 539

6. Posterior margin of last ventral segment of female almost straight, very slightly excavated at middle .... *furcilliatus* n. sp., p. 537

Posterior margin of last ventral segment of female sharply excavated each side of median sinuation .... *neomexicanus* Tuthill, p. 537

7. Markings of vertex not definitely six spotted, anterior pair usually U-shaped, posterior pair smaller .... *vinculatus* (Ball), p. 538

Markings of vertex definitely six spotted 8

8. Middle pair of spots on vertex small, not in form of broken cross band. *sexmaculatus* (Gill. & Bk.), p. 538

Middle pair of spots on vertex much larger, usually in form of a broken crossband, 9

9. Posterio-ventral corner of male pygofer without hook .... *discessus* (Van D.), p. 538

Posterior-ventral corner of male pygofer with hook 10

10. Pygofer hook extending posterio-dorsally, mesal lobes of last ventral segment of female angular 11

Pygofer hook extending ventrally; mesal lobes (if present) on last ventral segment of female rounded 12

11. Mesal notch of last ventral segment of female very deep; pygofer hook retrorse. *adversus* n. sp., p. 536

Mesal notch shallow .... *callidus* (Ball), p. 536

12. Male plates squarely truncate; pygofer hook small .... *truncatus* n. sp., p. 534

Male plates not squarely truncate 13

13. Male plates roundingly truncate, mesal margins shortest, pygofer hook very large and crooked, visible ventrally between apices of plates. .*signatifrons* (Van D.), p. 532

Male plates and pygofer hook not as above 14

14. Oedagus with sagittate tip almost no processes; pygofer hooks large 15

Oedagus with long apical processes; pygofer hooks small 16

15. Elytra with fuscous bands; male plates long, with more obliquely truncate apices. *crassus* (DeL.), p. 533

Elytra without fuscous bands, male plates very slightly, obliquely truncated. *sagittatus* n. sp., p. 533

16. Oedagus short, stout, with long retrorse, lateral processes almost parallel to shaft. *occidentalis* n. sp., p. 535

Oedagus long, slender. with apical processes shorter and but slightly retrorse. *rostratus* n. sp., p. 534

Hebecephalus signatifrons (Van D.)

Deltocephalus signatifrons Van Duzee, E. P. Trans. Am. Ent. Soc., p. 305, XIX, 1892.

From a study of the male and female types of this species, including the internal male genitalia, it is apparent that there has been a great deal of confusion as to the true identity of this species. The distinctive genital characters of the male and female revealed in this study are given here and this pair are designated lectotypes.

External Genitalia. Female, last ventral segment with posterior margin sharply excavated from prominent lateral angles to a large rounded lobe either side of a deep median notch with distinct tooth at base. Male valve short, quite obtuse; plates about twice as long as valve, very broad, roundingly truncate apices, inner margin shorter. Posterioventral corner of pygofer with very large, crooked hook visible between apices of plates.

Internal Genitalia. Oedagus long and slender, apex sagittate with a small retrorse ventral barb on each side of shaft behind head.

Hololectotype male, and allolectotype female, from the mountains of Colorado, dissected and figured. Types in collection of Iowa State College, Ames, Iowa. Numerous specimens of this species are at hand from Colorado and San Francisco Mts., Flagstaff, Ariz., elev., 11,000 feet.

Hebecephalus crassus (DeLong)

Deltocephalus signatifrons var. *crassus* DeLong, D. M. Ohio State University Studies, vol. II, 1926.

A study of the internal male genitalia shows this to be a distinct species. It is characterized by the very obliquely truncate male plates. The posterior-ventral corner of the pygofer bears a very large hook.

Internal Genitalia. Oedagus slender, evenly curved dorsally, with sagittate apex.

A paratype and two other specimens from the type locality were studied.

Hebecephalus sagittatus n. sp.

. Resembling *H. crassus* (DeL.) but without a banded appearance of elytra, male plates much smaller, and but slightly truncate; posterior margin of last ventral segment of female but shallowly notched. Length, 3.5 mm.

Color. Cinereous with fuscous markings. Vertex with two oblique apical triangles, four quadrate spots on disc, anterior ones connected to margin, fuscous. Pronotum and scutellum flecked with fuscous. Elytra with veins light, more or less regularly margined with fuscous. Venter mottled.

Structure. Vertex bluntly angled, about one sixth wider between eyes than mesal length. Elytra longer than abdomen.

External Genitalia. Female, last ventral segment with lateral angles prominent, posterior margin shallowly excavated to two very broadly rounded lobes separated by a broad, shallow, mesal notch. Male valve slightly wider than long; plates about as long again as valve, narrowed to rounded, slightly truncate apices. Posterioventral corner of pygofer with medium hook.

Internal Genitalia. Oedagus of medium length, shaft slender, evenly curved to sagittate tip, shaft with two small lateral teeth just behind head.

Holotype, male; allotype, female; 2 male and 3 female paratypes, Hot Lake, Oregon, July 13, 1931, R. H. Beamer.

Hebecephalus truncatus n. sp.

Resembles *H. signatifrons* (Van D.), but much lighter colored, and male plates very broad and squarely truncate. Length, 3.5 mm.

Color. Cinereous with fuscous markings. Vertex with two oblique apical dashes, spot between these and ocelli, and four more or less quadrate spots on disc, fuscous. Pronotum and scutellum flecked with fuscous. Elytra with veins light, more or less regularly margined with fuscous. Venter light, mottled with fuscous.

Structure. Vertex bluntly angled, about one sixth wider between eyes than mesal length. Elytra longer than abdomen.

External Genitalia. Female, last ventral segment with posterior margin sharply excavated from prominent lateral angles to a large rounded lobe either side of a deep median notch with distinct tooth at base. Male valve bluntly obtuse, plates slightly narrower than valve at base, about twice as long, apices squarely truncate. Posterioventral corner of pygofer with medium hook.

Internal Genitalia. Oedagus short, fairly slender, sharply bent dorsally near apex, two slender, retrorse, lateral processes arising at apex, almost half as long as shaft; a pair of very small lateroventral teeth about midway of shaft.

Holotype, male; allotype, female; one male paratype Farwell Creek, S. Sask. Can.

Hebecephalus rostratus n. sp.

Resembling *H. signatifrons* (Van D.), but smaller without banded appearance of typical *signatifrons,* male plates narrower, obliquely truncated and pygofer hook shorter. Length, 3.5 mm.

Color. Cinereous with fuscous markings. Vertex with two oblique apical dashes more or less suffused with orange and two pairs of more or less rectangular transverse spots on disc, fuscous. Pronotum and scutellum more or less flecked with fuscous. Elytra with veins white, more or less regularly fuscous margined. Venter dark, more or less flecked with white.

Structure. Vertex bluntly angled, one sixth wider between eyes than at middle. Elytra longer than abdomen.

External Genitalia. Female, last ventral segment with fairly prominent lateral angles, posterior margin with prominent hemispherical lobes each side of very broad mesal notch. Male valve broadly rounded; plates wider than valve at base, lateral margins almost straight to obliquely truncate tips. Noticeably narrower than in *H. signatifrons.* Pygofer with short, sharp, curved, posterioventral hook.

Internal Genitalia. Oedagus long, fairly slender, shaft with pair of lateral apical retrorse, curving processes, diverging from shaft at 45 degrees, about one fourth as long as shaft.

Holotype, male, Cheyenne Co., Kan., July 1, 1925, R. H. Beamer; allotype female, Lawrence, Kan., August 9, 1934, R. H. Beamer; paratypes as follows: 16 males and 8 females, Flagstaff, Ariz., Aug. 5, 1933, R. H. Beamer; 2 males same data as holotype.

Hebecephalus occidentalis n. sp.

Resembling *H. rostratus* B. & T., but with much stouter male oedagus, with larger, longer, lateral apical processes more nearly parallel to shaft. Length, 3 mm.

Color. Cinerous with fuscous markings. Vertex with two oblique apical dashes more or less suffused with orange and two pairs of more or less rectangular transverse spots on disc, fuscous. Pronotum and scutellum more or less flecked with fuscous. Elytra with veins white, more or less regularly fuscous margined. Venter dark, more or less flecked with white.

Structure. Vertex bluntly angled, one sixth wider between eyes than at middle. Elytra longer than abdomen.

External Genitalia. Female, last ventral segment without prominent lateral angles, posterior margin almost straight with two large hemispherical median lobes separated by a moderately wide notch. Male valve narrow, obtusely angled. Plates wider than valve at base, lateral margins almost straight to obliquely truncate tips. Pygofer with short, sharp, curved, posterioventral hook.

Internal Genitalia. Oedagus very short and stout; lateral pair of apical retrorse, slightly divergent processes almost as long as shaft.

Holotype, male; allotype, female; and numerous male and female paratypes, Republic, Washington, August 6, 1931, R. H. Beamer. Other specimens are at hand from British Columbia, Montana, and Colorado.

Hebecephalus callidus (Ball)

Deltocephalus callidus Ball E. D. Can. Ent., XXXI, p. 306, 1899.

This species is known only from the three female types taken at Pullman, Washington, and in the collection of E. D. Ball.

Hebecephalus adversus n. sp.

Resembling *H. callidus* (Ball), but markings of the vertex are quite different, last ventral segment of female with median slit, and both sexes larger. Length, male, 3.5; female, 4 mm.

Color. Cinereous with fuscous markings. Vertex with two prominent apical triangles usually drawn into marginal line, including ocelli, black. Interrupted transverse band behind ocelli and large spots near base much lighter. Pronotum flected with fuscous. Scutellum with large spot in each basal angle and smaller median pair. Elytra with veins lighter, heavily and irregularly marked with fuscous. Upper half of face dark with light arcs, lower half light.

Structure. Vertex bluntly angled, very slightly wider between eyes than mesal length. Elytra as long as abdomen in female and longer in male.

External Genitalia. Female, last ventral segment with lateral angles prominent, posterior margin shallowly excavated to two prominent angulate lobes separated by a straight-sided notch of varying width. Male valve roundingly obtuse, much wider than long; plates as wide as valve at base, lateral margins almost straight to truncate tips, mesal margin shorter. Pygofer exceeding plates by about one third their length, hook long, slender, visible, extending posteriodorsally.

Internal Genitalia. Oedagus long and slender, in lateral view slightly curved dorsally most of its length then sharply bent dorsally with tip curved out, in dorsoventral view shaft straight with pair of small lateral tubercles one third distance from tip. Apical third of style distinctly avicephaliform.

Holotype male, allotype female, 4 female paratypes North Powder, Oregon, July 13, 1931, R. H. Beamer; 1 male and 3 female paratypes Barclay, Utah, July 2, 1931, R. H. Beamer; 1 male paratype Anthony Lake, Oregon, July 11, 1931, J. O. Nottingham.

Hebecephalus tener Beamer & Tuthill

Hebecephalus tener Beamer and Tuthill. Jour. Kans. Ent. Soc., vol. 7, No. 1, p. 16, 1934.

This mountain species is near *H. blandus* (Gill.), but quite distinct. It may be separated by the differences in the posterior margin of the last ventral segment of the female. The internal male genitalia are here described for the first time.

Internal Genitalia. Oedagus with long slender shaft, a pair of large retrorse lateral processes at apex, almost half as long as shaft.

The pygofer of this species has no hook on the posterioventral corner.

Hebecephalus neomexicanus Tuthill

Hebecephalus neomexicanus Tuthill, L. D. Jour. Kans. Ent. Soc., vol. III, No. 2, p. 44, 1930.

This species is known only from the type female.

Hebecephalus furcilliatus n. sp.

Resembles *H. neomexicanus* Tuthill, but the vertex is much sharper, the posterior margin of the last ventral segment of the female is almost straight instead of deeply sinuate. Length, 2.5 to 3 mm.

Color. Whitish with light fuscous markings. Vertex with two oblique dashes at apex; two somewhat broad irregular vittae arising near ocelli extending to base, fuscous. Four faint, longitudinal vittae on pronotum. Elytra semihyaline, veins white, irregularly margined with fuscous. Face light with dark arcs. Venter light, more or less infuscated.

Structure. Vertex acutely angled, mesally half again as long as width between eyes. Elytra shorter than abdomen in females, exceeding it in males.

External Genitalia. Female last ventral segment with lateral margins rounding to almost straight posterior margin but slightly excavated on median fourth, black rectangular spot bordering excavation. Male valve broader than long; plates narrower than valve at base, about twice as long, lateral margins sinuate to blunt apices, about one half their greatest width. Pygofer pointed, exceeding plates by about length of valve, lacking posterioventral hook.

Internal Genitalia. Oedagus with heavy shaft, larger at base, bent dorsally almost at right angles on outer third with pair of flaring, lateral, apical, processes and a larger, bifid, retrorse process arising ventrally on curve. Style almost straight on apical third, slightly narrowed to rounded apices, slightly crenulate on inner margin.

Holotype, male; allotype, female; and 6 male and 11 female paratypes, Vaughn, N. Mex., June 5, 1933, R. H. Beamer; 1 male and 3 females New Kirk, N. Mex, June 5, 1933, R. H. Beamer.

Hebecephalus scriptanus Oman

Hebecephalus scriptanus Oman, P. W. Proc. Ent. Soc. Wash., p. 77, vol. 36, No. 4, April, 1934.

Paratypes of this species are at hand. No specimens other than the type series females have been reported.

Hebecephalus sexmaculatus (Gill. & Bk.)

Deltocephalus sexmaculatus Gillette and Baker, Hemiptera Colo., p. 88, 1895.

We have dissected specimens of this mountain species from the type locality. The internal male genitalia are very peculiar, showing no very close relationship to any of the known species.

Internal Genitalia. Oedagus in dorso-ventral view straight, fairly stout, broad basally, somewhat tapered to blunt apex. In lateral view shaft slightly curved dorsally, slightly swollen at apex, with extremely heavy, large basal processes.

Pygofer hook, short, stout and strongly curved.

Specimens are at hand from Wyoming and Colorado.

Hebecephalus vinculatus (Ball)

Deltocephalus vinculatus Ball, E. D. Can. Ent. XXXI, p. 191, 1891.

Material from Wyoming which we have had for study and which to us seems to agree in every way with Ball's description does not agree with Delong and Sleesman's drawings of the internal genitalia. Until such time as type material can be examined this discrepancy cannot be eliminated.

Hebecephalus discessus (Van D.)

Deltocephalus discessus Van Duzee, E. P. Proc. Calif. Acad. Sci., p. 416; 1925.

A male paratype of this species was studied.

Internal genitalia. Oedagus short and stout, abruptly curved dorsally near middle with pair of slender, lateral, retrorse, processes arising well back from apex.

One male and one female from Tehachapi, Cal., besides the paratype, were studied.

Hebecephalus blandus (Gill.)

Deltocephalus blandus Gillette, C. P. Colorado State Agri. Exp. Sta. Bul. 43, p. 26; 1898.

This is a very distinct little mountain species. The type was examined.

Hebecephalus cruciatus (Osb. & Ball)

Deltocephalus cruciatus Osborn and Ball. Proc. Dav. Acad. Sci., VII, p. 77; 1898.

A cotype of this species was sent to us by Dr. H. H. Knight of Iowa State College for this study. It is figured and here designated a hololectotype. The specimen is in the collection of the Iowa State College, Ames, Iowa.

External Genitalia. Male valve obtusely rounded, wider than long. Plates wider than valve at base, rather long and evenly narrowed to obliquely truncate tips. Pygofer with long sharp hook on posterioventral corner. This is one of the best diagnostic characters of this species.

Internal Genitalia. Oedagus stout, of medium length, in dorsoventral view angularly enlarged before apex. Styles on outer third scimitar shaped.

PLATE LIV

Fig. 1. *Alapus mendosus* (Ball). Ventral view of tip of male abdomen; 1a, last ventral segment of female.

Fig. 2. *Alapus fraternus* (Ball). Ventral view of tip of male abdomen; 2a, last ventral segment of female.

Fig. 3. *Alapus angulatus* n. sp. Ventral view of tip of male abdomen; 3a, last ventral segment of female.

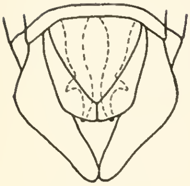
Fig. 4. *Alapus elongatus* n. sp. Ventral view of tip of male abdomen; 4a, last ventral segment of female.

Fig. 5. *Alapus acutus* n. sp. Ventral view of tip of male abdomen; 5a, last ventral segment of female.

Fig. 6. *Alapus marcidus* Beamer and Tuthill. Ventral view of tip of male abdomen; 6a, last ventral segment of female.

Fig. 7. *Alapus attenuatus* Lawson. Ventral view of tip of male abdomen; 7a, last ventral segment of female.

PLATE LIV



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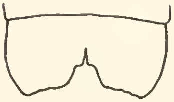

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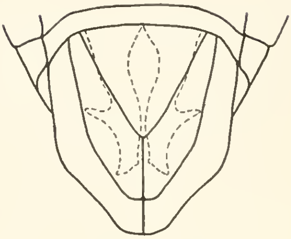

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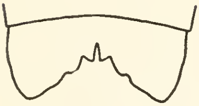

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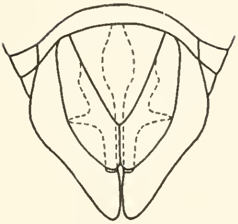

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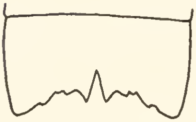

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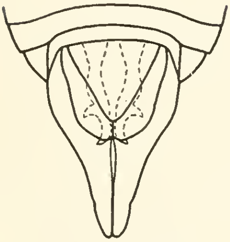

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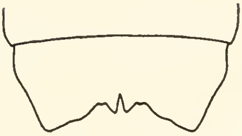

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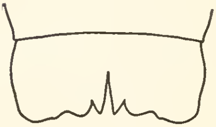

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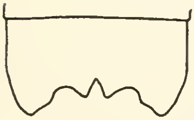

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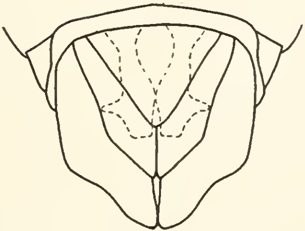

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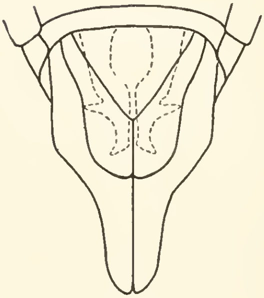

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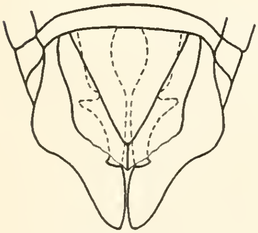

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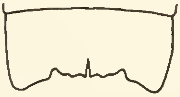


7a

PLATE LV

Fig. 1. *Hebecephalus signatifrons* (Van D.). Ventral view of tip of male abdomen; 1a, dorsoventral view of oedagus; 1b, last ventral segment of female.

Fig. 2. *Hebecephalus crassus* (DeL.). Ventral view of tip of male abdomen; 2a, dorsoventral view of tip of oedagus.

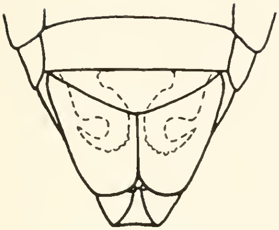
Fig. 3. *Hebecephalus sagittatus* n. sp. Ventral view of tip of male abdomen; 3a, last ventral segment of female; 3b, dorsoventral view of tip of oedagus.

Fig. 4. *Hebecephalus truncatus* n. sp. Ventral view of tip of male abdomen; 4a, dorsoventral view of tip of male oedagus; 4b, last ventral segment of female.

Fig. 5. *Hebecephalus occidentalis* n. sp. Ventral view of tip of male abdomen; 5a, dorsoventral view of tip of oedagus; 5b, last ventral segment of female.

Fig. 6. *Hebecephalus rostratus* n. sp. Ventral view of tip of male abdomen; 6a, last ventral segment of female; 6b, dorsoventral view of tip of oedagus.

PLATE LV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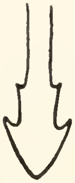
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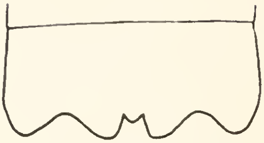
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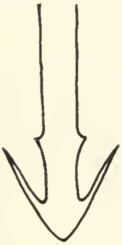
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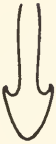
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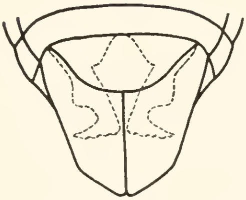
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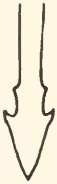
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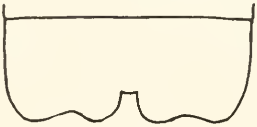
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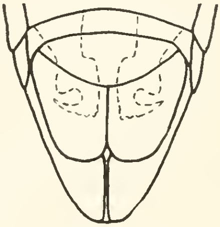
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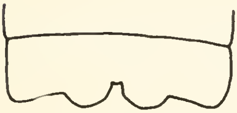
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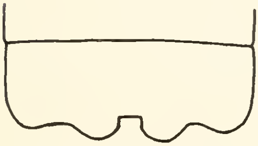
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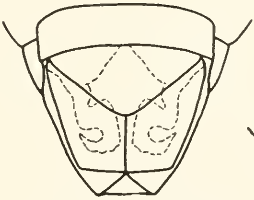
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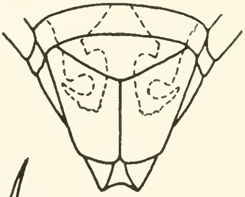
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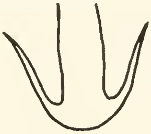
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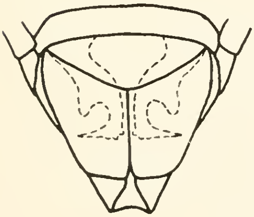
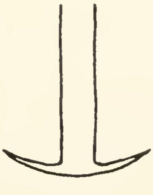

6 Hebecephalus rostratus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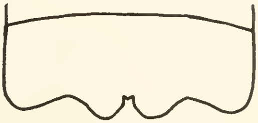
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PLATE LVI

Fig. 1. *Hebecephalus furcilliatus* n. sp. Ventral view of tip of abdomen of male; 1a, dorsoventral view of oedagus; 1b, last ventral segment of female; 1c, lateral view of oedagus.

Fig. 2. *Hebecephalus cruciatus* (Osb. & Ball). Ventral view of tip of abdomen of male; 2a, dorsoventral view of tip of oedagus.

Fig. 3. *Hebecephalus blandus* (Gill. & Baker). Last ventral segment of female.

Fig. 4. *Hebecephalus tener* Beamer and Tuthill. Dorsoventral view of oedagus.

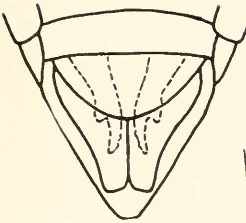
Fig. 5. *Hebecephalus adversus* n. sp. Ventral view of tip of abdomen of male; 5a, lateral view of oedagus; 5b, last ventral segment of female.

Fig. 6. *Hebecephalus discessus* (Van D.). Lateral view of oedagus; 6a, dorsoventral view of oedagus.

Fig. 7. *Hebecephalus sexmaculatus* (Gill. & Baker). Lateral view of oedagus; 7a, dorsoventral view of oedagus.

Fig. 8. *Hebecephalus vinculatus* (Ball). Dorsoventral view of oedagus; 8a, lateral view of oedagus.

PLATE LVI



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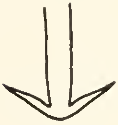

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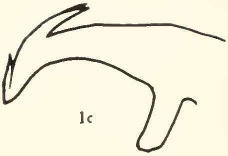

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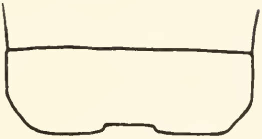

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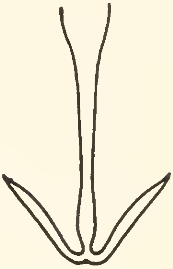

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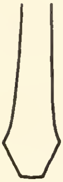

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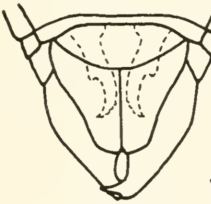

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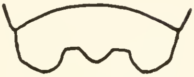

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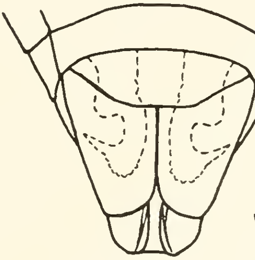
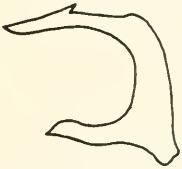
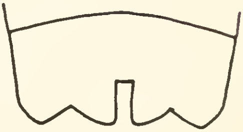


5 Hebecephalus adversus



6 Hebecephalus discessus



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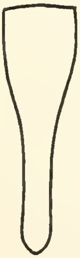

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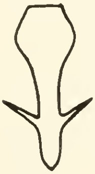
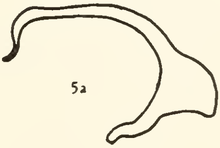


6a



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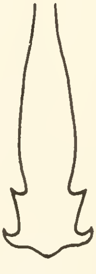
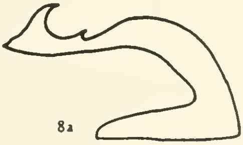


8 Hebecephalus vinculatus



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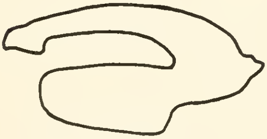
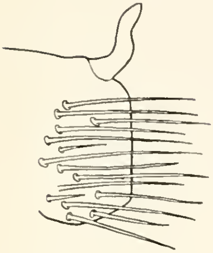


7 Hebecephalus sexmaculatus

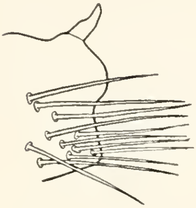
PLATE LVII

Lateral view of pygofers of species of *Hebecephalus.*

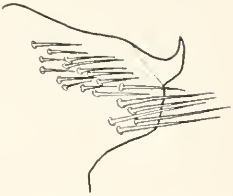
PLATE LVII



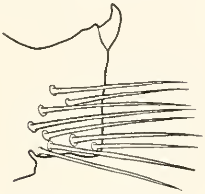
Hebecephalus signatifrons



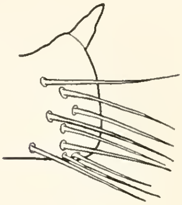
Hebecephalus truncatus



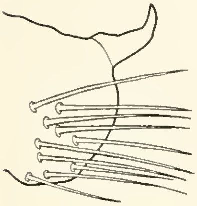
Hebecephalus sexmaculatus



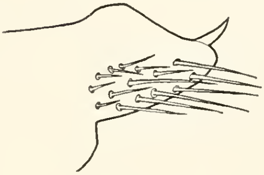
Hebecephalus rostratus



Hebecephalus sagittatus



Hebecephalus crassus



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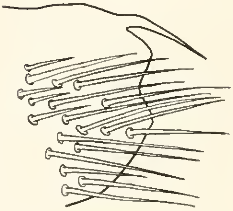
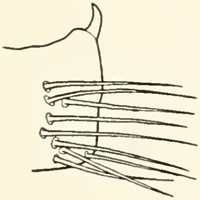
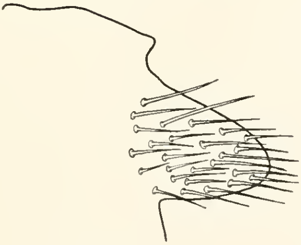


Hebecephalus adversus



Hebecephalus occidentalis



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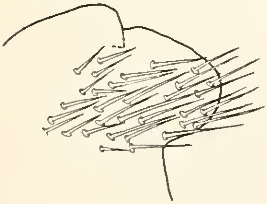
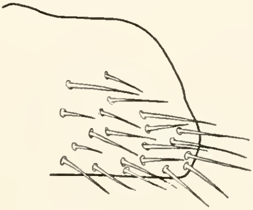
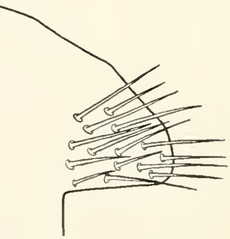


Hebecephalus tener



Hebecephalus furcilliatus



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